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THE WORK OF THE N. E. L. A.

The address of President John F. Gilchrist at the Seattle convention brings into strong relief the admirable work that is being done by the National Electric Light Association and the numerous directions which its activities are taking. Its growth under the present active and efficient management needs no comment. Of its more familiar activities the *Bulletin* easily holds the first place. It is a mine of technical information of a wonderfully varied character and a value which it is difficult to overestimate. President Gilchrist's address directs attention to many matters regarding the policy and relations of the organization in connection with its future work. One suggestion with which we are in the heartiest accord is that it is desirable for the association to cultivate close and friendly relations with the public service commissions of the country. These commissions, now relatively few in number, are certain to assume in the next few years a position of commanding importance in all the dealings of public service corporations with their patrons. The commissions have, on the whole, not shown themselves inimical to the interests of the central stations. At some times and in some places they have seemed to bear hard upon the business, but as time goes on and more commissions come into existence we are disposed to think that they will be found, as they have proved themselves already in certain cases, not unfriendly. We believe that central-station managers as a whole intend to give the public a square deal, and when the public service commissions come, as they will if friendly relations are maintained, to realize this situation, they will be able to harmonize public and corporate interests in a way that will prove very gratifying. It certainly is worth while for the National Electric Light Association to get in close touch with them, to assure them of their willingness to co-operate in securing fair play for all parties concerned, and to give them every reasonable assistance that is practicable. In not a few cases the commissions have proved themselves very fair and friendly, and there have already been many decisions which will tend to render the business more safe and stable in the long run.

Another valuable relationship to which President Gilchrist directs attention is that with the educational centers of the country. From every point of view, financial and sociological as well as technical, close relations with the institutions that are training the next generation of engineers and of citizens must prove to be valuable to public service corporations of every kind. On the technological side, however, there are many problems of value to the central-station industry which can be very appropriately and advantageously handled in the technological schools, and closer co-operation with such schools will lead to useful developments of this kind. There have been many

cases of mutual helpfulness between the stations in a college town and the technological faculty and students. Close association with an active industry is wonderfully good training for young men. An intimate association with the teaching staff of a university is likewise an extremely good thing for those who have technical problems to solve, some of them of an unexpected and forbidding character.

Still another subject of importance is the recrudescence of the old municipal-ownership fallacy. Twenty years ago it was uppermost in the minds of many members of the association as a constantly working source of annoyance and anxiety. Then for a time municipal ownership subsided, the public having learned some bitter lessons about the interrelations of politics and sound business principles. Now municipal ownership has started into activity again after a recent period of decline. It seems to be one of the immutable laws of human nature that no one is willing to learn from the experience of others, and many a city will have to gather a harvest of unpleasant and costly experiences before becoming convinced of the futility of municipal lighting. The National Electric Light Association could do no more valuable work both for public and central-station interests than to gather and spread out in uncompromising array the real facts in the case—all the facts, few of which are pleasant. If the people really understood fully what municipal lighting has meant in the vast majority of the cities that have tried it, little would be heard in the future of this particular kind of public enterprise. It has been, and will always prove to be, an error to present merely the worse features of municipal ownership. A campaign of enlightenment of the public on municipal ownership and operation if undertaken by central stations should be so conducted as to remove all traces of the thinly-veiled one-sided statements that have been sent out in the past by interested parties. The collection of data on only one side of the question must prove much less effective than the presentation of all of the data, both good and bad, for the bad will greatly overshadow the good.

THE ENLARGEMENT OF A BIG STATION.

In another column will be found a very instructive account of the steps taken to reinforce the equipment of the Redondo (Cal.) station. The original plant was an extremely well-designed and efficient one, using compound reciprocating engines, and oil burners under the boilers. Three 5000-kw units were in use. This plant was installed about four years ago, and since then the very rapid growth of Los Angeles and its suburbs and the increase of railway traffic, which this station was designed to handle, have compelled prompt enlargement. The form which this enlargement took is very striking evidence of the usefulness of the steam turbine in reducing the required floor area. It was found actually possible to install in the original engine-room two 15,000-kw turbo-generators, thus multiplying the output rating of the station by three without increase of area. The turbines were installed and foundations erected on the place formerly occupied by a pump pit. Obviously this economy of space could not extend to the boiler plant, which had to be enlarged by eighteen new units, each rated at about 600 hp. The new boilers, like the old ones, are oil-fired and carry 190 lb. of steam as against 175 lb. in the original boilers. With a plant of this kind the boiler house is by far the most formidable part of the structure, and no pains were spared to make it safe and efficient.

As to the electrical part of the plant, the original machines generated energy directly at 18,000 volts, three-phase. The turbo-alternators generate at 9000 volts, and the pressure is then doubled by auto-transformers so that the new system is interchangeable with the old. There are two sets of operating busbars, to either of which any of the twenty-four 18,000-volt feeders may be connected. The interesting point about this plant, which otherwise is simply of well-planned modern design, is the success with which the turbine has been applied enormously to increase the output rating of the plant without enlarging the engine-room. The turbine has economy of floor space as one of its very strong points, but we know of no more striking example of its capabilities in this direction than the one before us.

THE TESTING OF LARGE WATT-HOUR METERS.

The ordinary watt-hour meter, as installed on electric consumption circuits, is charged with the duty of recording correctly on its dials the total electrical energy which has been delivered through its terminals. If the meter has an error of, say, 4 per cent too slow, its record, when translated into money valuation, will be correspondingly 4 per cent short. The larger the meter and the larger the amount of energy it delivers, the larger will be the sum of money involved in this percentage of error. Consequently, while it is recognized as important in central-station practice to test and check house watt-hour meters at regular intervals, it is of yet greater importance to test and check large watt-hour meters from time to time, in order to make sure that they are in good working order. Such large watt-hour meters may be located either at a consumption plant of large proportions or at a station switchboard. The testing of a small watt-hour meter on steady load is usually a comparatively simple matter. Either an indicating wattmeter or a watt-hour meter of a reliable standard type is inserted in circuit with the instrument to be tested, and the speed of the latter's rotor is observed in comparison with the corresponding correct value deduced from the standard apparatus. If the load under which the instrument is working fluctuates rapidly, a standard indicating wattmeter becomes unsuitable for the test, and a standard watt-hour meter is used or the instrument tested is removed from its working load and placed on a substituted steady load.

The testing of a large watt-hour meter is, however, much more troublesome than that of a small watt-hour meter. The difficulties in making the test increase perhaps as the square of the load to be measured, if difficulties may be regarded as being capable of numerical expression. In the first place, the small flexible leads and wires of the small instrument are replaced by massive rigid bars or cables on the large instrument; so that it takes much more time to insert the testing apparatus in the circuit. In the second

place, any change in the geometrical disposition of bars or cables may alter the magnetic field at the tested instrument and thus affect its behavior. Moreover, owing to the larger money value of the energy delivered by a large watt-hour meter, a higher degree of precision in its testing and checking is desirable. It thus comes about that the calibration of large watt-hour meters in place is an undertaking requiring considerable effort and care, even if their working loads are steady. If their working loads are rapidly fluctuating, as in street-railroad and traction service, standard indicating wattmeters become unsuitable, and standard watt-hour meters are necessary.

It is very awkward to transport and to insert in circuit with a large watt-hour meter an equally large standard instrument of the same type. It is very important that the standard watt-hour meter should be portable and not require massive connections. This means that it can only carry a certain portion of the current and load on the instrument under test. The shunting of the standard instrument is, however, very troublesome; because the multiplying ratio of the shunt must be known to a relatively high degree of precision, and this ratio is seriously affected by the temperature of the standard instrument coils.

An ingenious arrangement of apparatus for shunting a portable standard watt-hour meter of 40 amp rating, so as to carry a total measured direct current of 2000 amp, is described in the article by Messrs. F. A. Laws and C. H. Ingalls in this issue. It virtually consists of a Wheatstone bridge of a 50 to 1 ratio, the low-resistance side being composed of fixed alloy strips, and the high-resistance side being composed of one fixed alloy strip and the portable standard instrument coils, together with adjustable extra resistance to allow for temperature variations in coil resistance. When the bridge has been adjusted to balance, with the aid of a galvanometer in the bridge wire, the low-resistance side of the bridge bears the proper standard shunt ratio to the high-resistance side; so that the current in the standard portable watt-hour meter is a known fraction of that in the large watt-hour meter under test. The cables enter and leave the Wheatstone bridge side by side; so that their joint magnetic field becomes relatively unimportant, and the entire testing outfit is compact and portable.

ERRORS DUE TO IMPROPER WATT-HOUR-METER CONNECTIONS.

Three-phase watt-hour meters are ordinarily provided with two series and two shunt windings. The series windings are inserted in two of the mains, and the shunt coils are inserted between these and the third main. There are two methods of connection—first, primary connection, where the windings of the instrument are directly in the main circuits, and, second, secondary connection, where use is made of instrument transformers, with their primary coils in the main circuits and their secondary coils connected to the instrument.

With primary connection there is a possibility of making an error in the wiring of the meter by introducing one main reversed. If, however, the instrument is placed under load, the direction of insertion which gives the greatest speed to the meter disk will be found correct with ordinary power-factors. When, however, secondary connection is used, as in all extra-high potential systems, the chance for error in wiring is considerably increased, as is shown in the article by Mr. C. A. Howell in this issue. With eight instrument leads running from the meter to the transformer secondaries, there are various possibilities of misconnection. The only safe procedure in such cases is to test out the leads properly and then follow the diagram of connections as supplied by the instrument makers.

A STUDY OF ULTRA-VIOLET RADIATIONS.

A brief paper by Mr. M. Luckiesh in the current issue gives some interesting details of the photographic study he has recently made of the ultra-violet light given by various illuminants. Photography offers a very ready means of investigating ultra-violet radiation, and the particular point of interest in Mr. Luckiesh's paper is that he photographed the spectra obtained from various sources when of equal photometric intensity as reflected from a little block of magnesia. As a result the photographs obtained from the various sources are strictly comparable with each other for the conditions assumed. Of course, it must be understood that such a set of photographs is not comparable with another set of spectrum photographs taken under different conditions, and the differences may lead to erroneous conclusions if neglected. For instance, it appears from one of the photographs in question that the bare Nernst filament gives a spectrum extending into the ultra-violet scarcely to wave length 360 $\mu\mu$ and that the tungsten lamp, even when it has had ten times the relative exposure that was accorded to daylight, scarcely reaches 380 $\mu\mu$. Now, Uhler and Wood have found the Nernst filament a good source for ultra-violet down to 310 $\mu\mu$ or 320 $\mu\mu$, and several of the German investigators have traced the radiation from metallic-filament lamps easily down to or below the same point in spite of the inclosing globes. This difference may be due to the fact that Mr. Luckiesh used lantern slide plates, which are not of high sensibility, and evidently gave rather short exposures. Such differences may always be expected in photographic comparisons made with different apparatus and plates, as we have already intimated.

The feature of Mr. Luckiesh's work which is singularly interesting in view of the discordant reports from some of the foreign investigators is his comparison of the light of the sky with that of artificial illuminants. A glance at his photographs shows that the light of the sky is much richer in ultra-violet radiations than that of any of the ordinary artificial light sources. Few people realize how much light reaches one's eyes from the clear sky. Photometrically, it may be rather large compared with direct sunlight, and actinically, as measured by its action on photographic plates, it is peculiarly powerful. If ultra-violet light were as inimical to the eye as some of the earlier investigators thought, we should all be in a bad way from the light of the blue heavens. In view of the facts in the case it seems idle to waste any anxiety on possible dangers from the ultra-violet rays in artificial light.

DELAY IN PATENT OFFICE PROCEDURE.

A patent issued on Jan. 4, 1912, to Mr. G. B. Selden for an automobile is interesting both on account of the subject matter and by reason of the date on which the application was filed. A note on the overthrow of the Selden patent which formed the basis of control of the gasoline automobile industry appeared in our issue dated Jan. 12, 1911. The present patent relates to the mounting of the motor upon a steering axle and covers all types of prime movers, including electrical as well as gas. The original application for this patent was filed on May 8, 1879, so that there has been a delay of thirty-three years in the issuing of this patent. Between the date of application and the expiration of the patent the total time will be fifty years, or nearly three times the legal limit of seventeen years.

Details relating to the methods employed by the inventor, a patent attorney, in delaying the granting of the original patent controlling the automobile industry were given on page 698 of our issue dated Sept. 23, 1909. It was shown there that a delay of nearly seventeen years was obtained by taking advantage of the Patent Office allowance of two years between each step in amending the claims to overcome rejection.

In commenting on the patent issued on Nov. 5, 1895, which was applied for on the same date as the present patent, the United States Court of Appeals stated in 1911 that the applicant took full advantage of the period of inactivity permitted by the rules and statutes, and that it is apparent that he delayed just as long as possible the issue of the patent. During this long period the automobile art made marked advances along different lines, and when, in 1895, the patent was granted it disclosed nothing new. For the monopoly granted by his patent the inventor had nothing to offer in return, and the public gained absolutely nothing from his invention, whatever it was. Since the inventor, however, followed strictly the statutes and rules of procedure, the courts cannot exact a greater amount of expedition from him.

CANADIAN ELECTRICAL ASSOCIATION CONVENTION.

At the twenty-second annual convention of the Canadian Electrical Association, to be held at Château Laurier, Ottawa, on June 19, 20 and 21, the following papers will be presented: *Recent Developments in Lamps and Reflectors,* by Mr. J. G. Henninger; *The Influence of Ice on Water-Power Development,* by Prof. H. T. Barnes; *Distributing Systems for Outlying Districts and Small Plants,* by Mr. S. Bingham Hood; *Watt-Hour Meters, Past and Present,* by Mr. C. W. Baker; *New Business,* by Mr. Thomas F. Kelly; *Power Factor—Its Influence and Effect,* by Mr. D. H. Ross; *Commercial Electric Heating,* by Mr. McAllaster Moore; *Underground Construction,* by Mr. G. M. Gest. Reports will be presented by the following men as chairmen of the committees indicated: Mr. D. H. McDougall, membership committee; Mr. L. B. Webber, meter committee; Mr. Thomas F. Kelly, commercial committee; Mr. Parker H. Kemble, committee on rates and forms of contract; Mr. D. R. Street, committee on uniform accounting; Mr. W. C. Hawkins, public policy committee; Mr. R. G. Black, committee on standardization.

Among the entertainment features will be an informal dance and garden party tendered by the city of Ottawa on Wednesday evening at the Victoria Hotel, Aylmer, a banquet at the Château Laurier on Thursday evening, and a baseball game between representatives of manufacturing and operating companies. The president of the association is Mr. A. A. Dion, Ottawa, and the secretary is Mr. T. S. Young, 220 King Street West, Toronto, Ontario.

ROYAL RECEPTION TO RADIOTELEGRAPHIC DELEGATES.

At the reception given by King George and Queen Mary to the delegates to the International Radiotelegraphic Conference at Buckingham Palace on June 10 250 guests were present. During the business portion of the conference the subjects of precedence of messages and standardization of wave-length were fully discussed. Considerable opposition has developed to the proposal to increase the commercial wave-length.

DECISION IN ALUMINUM TRUST SUIT.

As forecast in our issues dated March 30 and May 25, a decree has been entered in the United States District Court at Pittsburgh against the Aluminum Company of America in accordance with the previous agreement made between the government and the defendant. As a result of the decree the company is forbidden to participate in any combination or agreement to control the output or prices of aluminum. It is enjoined from combining by stock ownership or otherwise with other manufacturers for this purpose. The decree abrogates alleged agreements to suppress competition between the Aluminum Company of America and the so-called Swiss or Neuhausen Company of Europe, the General Chemical Company, the Norton Company, the Pennsylvania Salt Manufacturing Company, Gustav A. Kruttschmitt and James C. Coleman, of Newark, N. J. The decree may be modified not oftener than once in every three years in case it is shown that substantial competition has arisen in the aluminum industry.

BOSTON CONVENTION A. I. E. E.

Arrangements have been completed for holding the twenty-ninth convention of the American Institute of Electrical Engineers in Boston from June 24 to 28. On Wednesday, June 26, a joint meeting will be held with the Illuminating Engineering Society, and on Thursday, June 27, a joint session will be held with the Society for the Promotion of Engineering Education. The headquarters will be at the Hotel Somerset, where a reception and dance will be given on the evening of Monday, June 24. At the opening session on Tuesday morning Mr. Gano Dunn will deliver his presidential address and will introduce President-elect Ralph D. Mershon.

Parallel sessions will be held on Tuesday morning, Thursday morning, Friday morning and Friday afternoon. The following papers will be presented: *Determination of Corona Losses at High Potential,* by Prof. C. Francis Harding; *Dielectric Strength of Air,* by Mr. F. W. Peek, Jr.; *Electric Strength of Air,* by Prof. J. B. Whitehead; *Measurement of Voltage and Current Over a Long Artificial Transmission Line at 25, 60 and 420 Cycles per Second,* by Dr. A. E. Kennelly and Mr. F. W. Lieberknecht; *Electrolytic Corrosion of Iron in Street Soils,* by Prof. A. F. Ganz; *The Electric Furnace,* by F. A. J. FitzGerald; *Simplification of Electrothermal Calculations; the Watt and Thermal Ohm,* by Dr. Carl Hering; *Vacua,* by Dr. W. R. Whitney; *Metallic Tungsten and Some of Its Applications,* by Dr. W. D. Coolidge; *Characteristics and Applications of Vibration Galvanometers,* by Mr. Frank Wenner; *The Convection and Conduction of Heat in Gases,* by Mr. Irving Langmuir; *Problems of Interior Illumination,* by Mr. Bassett Jones, Jr.; *Relations of Illuminating Engineering to Electrical Engineering,* by Dr. Louis Bell; *Demonstration of Some of the Relations of Color to Illumination Work,* by Dr. Herbert E. Ives; *Industrial Illumination and Average Performance of Lighting Systems,* by Mr. C. E. Clewell; *Rela-*

tion of Central Station Generation to Railway Electrification, by Mr. Samuel Insull; *Introduction, Definite Scope and Purpose of Report of Education Committee,* by Prof. J. P. Jackson; *Industrial Education as Applicable by Electrical Manufacturing Corporations to Their Own Organizations,* by Dr. Charles P. Steinmetz; *A Few Successful Types of Vocational or Industrial Education in the New England and Middle States,* by Prof. Henry H. Norris; *Telephone and Electric Operating Companies and Other Industrial Schools in and About New York City,* by Dr. Samuel Sheldon; *The Important Features of State Laws Relating to Publicly Supported and Controlled Vocational or Industrial Schools,* by Prof. Walter I. Slichter; *Organization of the Technical College as Related to Its Usefulness to the Industries,* by Mr. Ralph D. Mershon; *History and Development of Submarine Signaling,* by Mr. H. J. W. Fay; *The Wiring of Large Buildings for Telephone Service,* by Mr. Fred L. Rhodes; *The Vibration of Telephone Diaphragms,* by Mr. Charles F. Meyer and Prof. J. B. Whitehead; *Military Telegraph Lines Using the Polarized Sounder as Receiving Instrument,* by Mr. George R. Guild; *Measuring Stray Currents in Underground Pipes,* by Dr. Carl Hering; *Electrical Transmission of Electrical Measurements,* by Mr. O. J. Bliss; *Metering Large Direct-Current Installations,* by Mr. F. V. Magalhaes; *A Tubular Electrodynamometer for Heavy Currents,* by Mr. P. G. Agnew; *Measurement of Alternating Current of Low Value,* by Mr. M. G. Newman; *Electrical Measurements with Special Reference to Lamp Testing,* by Mr. Evan J. Edwards; *Measuring Alternating-Current Resistance and Comparing It with the Direct-Current Resistance,* by Dr. Edwin F. Northrup; *Measurement of Energy with Instrument Transformers,* by Mr. Alexander Maxwell, *Induction Type Indicating Instruments,* by Mr. Paul MacGahan; *The Squirrel-Cage Induction Generator,* by Messrs. H. M. Hobart and E. Knowlton; *Efficiency of Rotating Electrical Machines,* by Mr. E. M. Olin; *Operating Characteristics of Large Turbo-Generators,* by Mr. A. B. Field; *Motor-Starting Currents as Affecting Large Transmission Systems,* by Mr. P. M. Lincoln; *Characteristics of a Large Unipolar Generator,* by Mr. B. G. Lamme; *Single-Phase Induction Motors,* by Mr. W. J. Branson; *Excitation of Alternating-Current Generators,* by Mr. D. B. Rushmore; *Compensating Wattmeters,* by Mr. A. L. Ellis; *Potential Transformer Testing,* by Mr. J. R. Craighead; *Measuring Permeability with Alternating Current,* by Messrs. L. T. Robinson and John D. Ball; *Measuring Maximum Values in High-Voltage Testing,* by Dr. C. H. Sharp and Mr. F. M. Farmer; *Hot-Wire Instruments,* by Messrs. A. W. Pierce and M. E. Tressler; *Incandescent Lamps as Resistors,* by Mr. T. H. Armine; *Resonant Circuit Frequency Indicator,* by Messrs. W. H. Pratt and D. R. Price; *Wheatstone Bridge Rotating Standard Method of Testing Large Capacity Watt-Hour Meters,* by Messrs. C. H. Ingalls and J. W. Cowles; *The Testing of Instrument Transformers,* by Messrs. P. G. Agnew and F. B. Silsbee; *Localizers, Suppressors and Experiments,* by Prof. E. E. F. Creighton and Mr. J. T. Whittlesey; *The Runaway Speed of Waterwheels and Its Effect on Connected Rotary Machinery,* by Mr. Daniel W. Mead; *Relay Protective Systems,* by Mr. L. L. Eldem; *The Transient Reactions of Alternators,* by Messrs. W. A. Durgin and R. H. Whitehead; *Application of Electric Drive to Paper Machines,* by Mr. J. S. Henderson, Jr.; *Electricity on the Farm,* by Mr. Putnam A. Bates.

Among the entertainment features will be trips by automobiles and launches for the ladies, and visits to the generating stations of the Edison Electric Illuminating Company and the Boston Elevated Railway Company, the Massachusetts Institute of Technology and the Lynn works of the General Electric Company. The banquet will be held and the Edison Medal presented to Mr. George Westinghouse in the Hotel Somerset on Thursday at 7 p. m.

OPENING SESSIONS OF N. E. L. A. CONVENTION.

With the arrival on Sunday of the various special trains, including the "Red" special de luxe from New York, the "Pink" special by way of the Canadian Rockies from New York, the "Green" special by way of Canada from Chicago, the "Orange" special from Chicago and St. Paul, the "Purple" special from St. Louis and the "Golden Poppy" special from San Francisco and Los Angeles, all ahead of time, the thirty-fifth convention of the National Electric Light Association at Seattle, Wash., may be said to have sprung into being. The indications are that the registration will reach 1500.

Forty hotels in Seattle were in readiness to minister to the comfort of the delegates and guests. Some of these were more in demand than others, and as a consequence the reservations for them soon exceeded their accommodations. The greater part of the delegates are quartered at twelve of the leading hotels, and the smaller, less central houses absorbed the others, who failed to make advance arrangements. In anticipation of the arrival of the delegates, Mayor G. F. Cotterill of Seattle issued a proclamation requesting the business men to decorate their buildings and in other ways to show their appreciation of the honor paid the city. The Hotel Washington, which served as the semi-official headquarters of the congress, was appropriately decorated with electric flags of many nations, the lamps being connected to a flasher so as to impart a waving effect. The municipal department also festooned the principal streets leading from the largest hotels to the Armory with varicolored incandescent lamps, and in addition the exterior of the Armory was illuminated by twelve flaming-arc lamps suspended from the turrets and two luminous-arc lamps on posts set up on the southern terrace.

The badge of the association was outlined in lamps over the main entrance of the convention headquarters. When the convention proper began with the opening of the exhibits and the reception to President and Mrs. John F. Gilchrist on Monday night, that section of the city in which the Armory and the leading hotels are located was ablaze with light. Never in the history of the association was an exhibition opened with less commotion and in more readiness than the electric show on Monday night. The exhibition hall itself was dazzling in brilliance. Hiding the roof trusses and the woodwork of the balcony was an immense canopy of cream and garnet. The ceiling treatment was divided into five distinctive divisions longitudinally and eight sections transversely, and where the sections met art-glass chandeliers and immense sunbursts of tungsten lamps (twenty-one fixtures in all) were suspended. The booths themselves were constructed on Colonial lines, the cornices lighted by tungsten lamps hidden from view, having the name of each exhibitor in letters of gold. The general treatment of the booths was in white and gold with the exception of the floor, which was stained in oak and covered with rugs. A complete description of the exhibition will appear in next week's issue.

The reception to President and Mrs. Gilchrist was held in the principal meeting room, the walls of which were hidden behind fir trees, forming an exquisite background for innumerable bunches of roses gathered by the local lighting company and the lighting companies at Portland, Ore. In fact, so plentiful and fragrant were the roses that it appeared as if the rose carnival had been moved from Portland to Seattle for the occasion. Outside the reception room the northern terrace was transformed into a hanging garden lighted by the subdued glow from Japanese lanterns and shut off from the gaze of onlookers by various trees and floral decorations. The terrace itself was carpeted so that after the dances the guests could promenade and partake of refreshments and light lunches. The reception itself was a gala event for Seattle, all of the leading citizens having been invited to participate in this function. In the

receiving line, besides President and Mrs. Gilchrist, were First Vice-president and Mrs. F. M. Tait, Mr. and Mrs. H. J. Gille, Mr. and Mrs. J. E. Davidson, Past-presidents Arthur Williams and W. W. Freeman and a host of others familiar to the electric light fraternity. A promenade, concert and dance followed the reception, and the merrymaking was not brought to a close until early Tuesday morning.

On Monday afternoon, after the preliminaries of registration had been completed, the delegates and guests were taken in special cars to the campus of the University of Washington, where a game of baseball was played, in the presence of over 500 enthusiastic devotees of the national game, between the Pacific Coast baseball team and a nine made up of men from east of the Rockies. The coveted prize was the Westinghouse Cup, contested for last year in New York and held by the nine of the Edison Electric Illuminating Company of Brooklyn. To the dismay of the Eastern delegates, the game was won by the Western team, the score being 16 to 3.

FIRST GENERAL SESSION.

The first general session of the convention began promptly at 10 o'clock, with President Gilchrist in the chair. Every seat in the main room was occupied and remained so for the greater part of the session. The first speaker was the Hon. G. F. Cotterill, Mayor of Seattle, who in his welcoming address mentioned the rapid growth of the city, both commercially and numerically, likening its development to that of the electrical art. He admitted the obligation of the city to that art, especially in the washing down of hills by electrically operated pumps so as to permit of its logical expansion. As everyone visiting Seattle knows, the business center of the metropolis of the Pacific Northwest is well lighted, and Mayor Cotterill maintained that Seattle is the best-lighted city in America, backing up this contention with statistics showing that it possessed 1631 tungsten cluster posts and some 8000 additional lamps of various types on its 25 miles of streets. Readers of the *Electrical World* had a complete description of this municipal system given them in the June 1 number. After describing eloquently the scenic setting of Seattle with the Cascades to the east, the Olympics to the west, Mount Rainier to the south and Mount Baker to the north, the Mayor expressed the hope that all those in attendance would not only enjoy themselves but return to their homes enthusiastic in their praise of Seattle. He concluded with a very hearty welcome. On behalf of the association, President Gilchrist, in well-chosen words, thanked the Mayor for his presence and inspiring address, stating that the applause with which it was received was a sufficient indication of the fact that the words had struck a responsive chord. President Gilchrist then surrendered the chair to Vice-president Tait, while he delivered his presidential address.

PRESIDENT GILCHRIST'S ADDRESS.

In the introductory portion of his address President John F. Gilchrist called attention to the fact that much of the work of the association is now continuous from one general convention to another, the work now being accomplished largely by standing committees. The committee report has largely supplanted the paper by the individual.

President Gilchrist stated that there had been a fair increase in membership during the past year. Under the headway which it has obtained Class B membership will continue to extend rapidly, not only as a result of the formation of company sections but on account of the increasing desire on the part of individuals in the business to participate in the membership and get the advantage of publications. The greatest effort, however, should be in increasing the company, or Class A, membership. There seems to be much difficulty in attracting to the association the very companies which would derive the most benefit. Some way should be found to interest these people and show them that for a very small amount of money they can obtain advice and opinions along engineering, organization and commercial lines which would cost them many hundred times the membership fee if they went out to purchase such advice commercially.

The monthly *Bulletin* is growing yearly in importance. The association may most profitably increase the appropriation necessary for the work on the *Bulletin* with its Question Box. There is no doubt as to its very great usefulness at the present time, and it would seem that it has sufficient possibilities and may be of such great value to so large a percentage of the membership that the expense of making it larger each year would be thoroughly warranted. In the past the Question Box has been edited by volunteer editors supplied through the generosity of member companies, but after this year it will probably be handled in the secretary's office.

The plan of inviting state associations to affiliate with the national association is working out slowly. During the year the Northwest Association, comprising several of the states in that section of the country, the Michigan Electrical Association and the Iowa Association have voted to affiliate and have been taken in. This movement is a little slow, but the results are satisfactory. The presidents of the different affiliated associations, as ex officio members of the executive committee, have a voice in the management of the parent association, and their respective associations become a part of the national in fact as well as in name and membership.

There has been much growth during the year in the company sections. A few new sections have been formed, but the growth has been principally on account of the accession of a large number of members to the older sections. This work should be encouraged and extended as much as possible. Very few companies are too small to find a company section practicable. The experience of those companies which have been pioneers in the movement would indicate that nothing has done more for the association since it was first organized than the company section movement, which brings the whole body of the employees in touch with the association work, impresses them with their individual responsibilities, and through them creates an influence in the community which affords the greatest possible protection by establishing a good-will and a public sentiment in favor of the corporation which cannot be so well secured in any other way. The company which does not promote a company section within its ranks is denying itself and its employees a great deal of benefit which has a very decided money value.

The income of the association at the present time from all sources is somewhat over $100,000 per annum, but is hardly ample for the necessities of the organization, as it is desirable to lay aside a certain amount each year for the purpose of accumulating a reserve fund. It has not been possible to do this every year. Some little time ago the association started such a fund, and it has at the present time $15,000 invested in securities.

While a very large sum of money in a reserve fund may not be necessary or desirable and may even prove an embarrassment, an association of the size of this one, representing the very large interests which it does, should have a fund of at least $500,000 well invested, which would insure an income over and above that derived from other sources of from $20,000 to $25,000 a year. Such resources would give the association greater standing and would put it in a position to take up in emergency almost any work which might present itself. When one stops to consider that from $300,000 to $400,000 is spent by the members of the association in attending a single convention, and that this does not include the value of the time of the delegates, but only their out-of-pocket expense, the above does not seem an extravagant sum always to have on hand by an association which exists for the advancement and protection of

an industry which employs between 1500 and 2000 millions of dollars of capital.

A very slight effort for a few years would result in its accumulation, and the association would thereby be placed in a position to take up promptly almost any matter which might be necessary in the interests of its members, while the application of the yearly income to study and development outside of the ordinary routine of association work might be of incalculable benefit to the members.

A relationship which has not been cultivated in the past to the extent that it should be cultivated in the future is that between the National Electric Light Association and the various institutions of learning throughout the country. Not only is it important, from the standpoint of having men properly educated to prosecute the business and operate undertakings, to get in closer touch with the branches of such institutions that deal with the education of young men, but it is also desirable by more mutual acquaintance to get in a position to appreciate each other's points of view in order that the rising generation may have broad practical views regarding many of the great questions which are puzzling this country to-day, and particularly, fair views regarding the formation and operation of corporations—most especially, public utility corporations. A standing committee on relations with institutions of learning would, in the estimation of the speaker, be most desirable.

Still another relationship which it would be desirable for the association to cultivate would be one with the public service commissions of the country. While at the present time comparatively few of the states have established such commissions, they are increasing yearly in number. It is fair to conclude that the men on these commissions are earnestly desirous of arbitrating fairly between the public utilities authority over which is given to them and the people, but they naturally lack experience, and the N. E. L. A., without compromising its position as the bulwark of the rights of the central-station business, should maintain toward the commissions an attitude of cordial and friendly co-operation in arriving at what is right and fair in relations between public service corporations and the public.

The tide of public opinion with regard to the question of municipal ownership seems to ebb and flow. Six or seven years ago it seemed to be at the flood point. This was followed apparently by a decided revulsion from the idea of municipal ownership of utilities, but recently the municipal idea seems again to be becoming more popular. Political expediency and the self-interest of a certain proportion of the public will probably always be decided factors in this discussion, but these elements should be overcome and the question should be dealt with from the standpoint of the "greatest good to the greatest number" of people. If this problem is taken up intelligently it can be shown that under the conditions existing in the world to-day, and particularly in this country, better service can be rendered at the same price, or the same service at a lower price, in all branches of public utility work by privately owned corporations as compared with municipally owned ones. The difficulty encountered is that of making an intelligent comparison.

Apparently at the present time one decided cause of the increase of municipally owned plants is that many short-sighted owners of small properties, who have not been able to operate them successfully, have deliberately gone into the business of unloading their properties on the municipalities. Another important element in the increase of small municipal plants is the fact that in many small towns those in charge of the water-works are using their influence to have electric plants established in connection with the water plants. This in itself is no doubt fundamentally economical, but far-sightedness on the part of central-station people should result in the matter being arranged so that the privately owned company will take over the operation of the water system or at least provide the power for doing the pumping. Centralization of every supply is in the direction of economy, and no central station should rest while there is any possibility of extending that centralization.

A committee of the association for two years past has been making a careful study of electricity rates. The question of rates is one which has occupied a great deal of the attention of electrical people since the business was inaugurated, and while rate schedules have been established very generally which on analysis are quite similar in results, there is a deplorable lack of uniformity in the schedules themselves.

The question of rates is naturally one of paramount importance in the eyes of the public service commissions. At the present time these commissions are in many instances studying the question and have not felt sufficiently sure of their position to take any very radical steps, which is a rational and conservative view; but the time is close when, on the initiative of the companies which form the N. E. L. A., uniform rate systems must be put into effect. Full appreciation of the importance of this matter should result in some uniform practice in the matter of rates being indorsed within the next few years which may be gradually adopted until, as in the case of accounting, it comes to be recognized that there is decided uniformity among the companies in this respect.

Stimulated by last year's report of the public policy committee, a great deal of interest has been shown in plans for adding to the welfare of central-station company employees. Employees' clubs, savings and investment plans, pension schemes, athletic events, entertainments, the attendance of physicians and visiting nurses and similar arrangements for adding to the health, pleasure and general welfare of the employees are becoming yearly more common.

Somewhat in line with this class of work, the association has been fortunate this year in being instrumental in obtaining the appointment of a body known as the Resuscitation Commission, consisting of the most eminent medical and electrical men. This commission has been studying the effect of electrical shock on the human system in order to treat more intelligently and successfully cases of this kind: also to revise and prepare for publication rules and diagrams which will result in the application of first-aid methods in accordance with the most up-to-date practice.

In concluding his address, President Gilchrist commended the policy of the association in taking the initiative, from the standpoint of good business, as well as good ethics, in urging upon its members the adoption of the most modern ideas of broad and fair relationships between public utility companies and the public.

The usual custom of submitting the recommendation of the president to a committee for final report and definite action was followed. The committee consists of Messrs. W. C. L. Eglin, of the Philadelphia Electric Company, Philadelphia, Pa.; J. C. Davidson, of the Pacific Power & Light Company, Portland, Ore., and R. H. Ballard, of the Southern California Edison Company, Los Angeles, Cal. Following the appointment of the committee on the president's address, Mr. J. A. Britton, of the Pacific Gas & Electric Company, San Francisco, Cal., made a very eloquent address, inviting the association to hold its convention in San Francisco in 1915 at the time of the Panama-Pacific Exposition. San Francisco could hardly have chosen a better advocate than Mr. Britton, who extemporaneously and yet beautifully portrayed the scenic wonders of California, not forgetting to remind the association of the indebtedness of the art to that State for pioneer developments in the high-tension transmission of electrical energy.

Secretary T. Commerford Martin drew attention to the fullness of the announcements published in the program. The report of the committee on organization of the industry was presented by Mr. H. H. Scott, of the Doherty

Operating Company of New York, who read from manuscript. Statistics were given of the present status of the organization, the membership of which totals 12,084. The membership is apportioned as follows: Class A, 1134; Class B, 9725; Class C, 45; Class D, 240, and Class E, 940. During the year the gains in the respective classes have been as follows: Class A, 176; Class B, 3071; Class C, 26; Class D, 14; Class E, 132, making a total of 3419. During the year three geographic sections and nine new company sections have affiliated with the national body, so that there are now ten geographic sections and thirty-seven companies represented.

In his annual report Secretary Martin gave data showing the amount of detail work handled in the New York office and directed attention to the fact that out of an income of approximately $100,000 almost one-half is spent on the publications of the association. The cost of the *Proceedings* during the past year was approximately $20,000, to which must be added $7,000 for advance copies of papers and reports distributed at the New York convention. In order to reduce these expenses to a minimum, it is planned hereafter to subdivide the *Proceedings* into technical, commercial, accounting and transmission volumes. During the year 12,502 volumes of the *Proceedings* were printed, 2500 copies of the revised edition of the "Question Box" and 4000 copies of the "Electrical Solicitor's Handbook," while for the present convention an edition of the "Electrical Meterman's Handbook," a volume of nearly 1000 pages, has been prepared. In addition, the commercial section has brought out 2000 copies of the "Commercial Digest," in loose-leaf form, and three pamphlets devoted to specific branch work, namely, industrial lighting (20,000 copies), residence lighting (5000 copies) and street lighting (10,000 copies). During the year the commission of the association on the subject of resuscitation from electric shock has issued through the association a chart and pamphlet, 1500 copies of which were printed for distribution at the convention.

Mr. W. W. Freeman, of the Edison Electric Illuminating Company of Brooklyn, N. Y., presented a resolution instructing the secretary to send the greetings of the convention to Mr. L. A. Ferguson, regretting his absence and illness and expressing pleasure at the news of his convalescence. Mr. W. H. Blood, Jr., of Boston, presented the report of the insurance expert, showing progress made during the past year.

Following the presentation of this report Mr. T. C. Martin presented in abstract the first part of his report as the committee on progress. President Gilchrist announced that Mr. Arthur Williams, of New York, as chairman of the committee on library and the solicitor's handbook, had no report to submit. Mr. E. A. Edkins, of Chicago, then presented the report on the Question Box. This report was the only feature of the morning session which drew forth any discussion. Messrs. W. H. Hodge, Chicago; J. H. Seaman, Philadelphia; T. K. Jackson, Mobile; H. A. Niesse, Chicago; R. H. Ballard, Los Angeles; F. Osgood, Newark, and J. C. Parker, Rochester, took part in the discussion. Mr. Hodge submitted some notes prepared by Miss Louise B. Krause in which she strongly advocated the Dewey decimal system of classification proposed by the author and elaborated its many advantages. Mr. Seaman voiced the same sentiments. All of those taking part in the discussion emphasized the importance of the Question Box and its great usefulness to the entire central-station industry of the country.

The concluding paper of the session was one on "Expanded Loyalty," written by Mr. Paul Lupke, of Trenton, N. J., in his characteristic style. He was unable to be present, but suggested that experience has shown that while he had written the paper Mr. Martin would dramatize it. After the reading of Mr. Lupke's paper the first general session adjourned.

TRANSMISSION SECTION SESSIONS.

The meetings of the transmission section furnished the most diverting and popular feature of the opening sessions of the convention. In his address as chairman of the section, Mr. Henry L. Doherty reiterated his well-known views on the policy of the federal government in the matter of the conservation of water-power and other natural resources. He characterized the policy as one promulgated and sustained by extremists and immature political economists of destructive tendencies. The first transmission session on Tuesday evening was carried out in accordance with the printed program in our issue of May 4. The paper of Mr. C. H. Williams, Denver, was supplemented with interesting lantern slides and motion pictures showing the application of electrical energy to irrigation and other uses on farms in northern Colorado.

The second transmission session was held on Wednesday afternoon with a very large audience present. The special feature was an address by Hon. R. A. Ballinger, formerly Secretary of the Interior, who was received with enthusiastic applause. Mr. Ballinger said that a few years ago there was no classification of public lands with reference to hydroelectric power sites, but this situation soon gave way to the modern theories of extreme conservationists. Originally the public domain was wholly in the hands of Congress and not of the executive branch. Apparently it was intended gradually to transfer the public lands to bona-fide settlers. It was never intended that the government should stay in the land business as a landlord, yet this is apparently what the extreme conservationists would now have the government do. The doctrine of conservation as laid down by these extremists is ridiculously unpractical. Mr. Ballinger expressed the opinion that the title to the public lands should be turned over to the various states so that each community may regulate the development of its own natural resources. The policy of the present administration to regulate the development of natural resources under public domain is burdensome and unreasonable in the extreme and constitutes a serious bar to progress. It is driving Western farmers to Canada and causing capital to seek other fields. A bill was introduced in Congress in 1910 to turn the water-power sites over to the state governments, but this met with the antagonism of the ultra-conservationists because they feared to lose their bureaucratic power and their grip on the public domain. Mr. Ballinger is opposed to President Taft's policy of leaving coal lands under the ownership of the government and maintained that the present conservation policy followed by the government is in reality very wasteful. Mr. Ballinger closed his address with an appeal for truth and justice and deplored the muckraking activities of the magazines of the country and the unchecked impunity with which they attack the reputations of men in public life.

Mr. J. A. Britton, of the Pacific Gas & Electric Company, followed with a brief address indorsing the sentiments expressed by Mr. Ballinger. Chairman Doherty contributed a few remarks along the same line, as did also Mr. D. B. Rushmore.

At the session of the transmission section on Wednesday afternoon it was voted to change the name of the section to the "hydroelectric and transmission section."

The large attendance at each of the commercial sessions testified to the increasing interest the new-business idea is attracting from central-station men. The keynote of the commercial meetings was struck at the beginning of the first session of Tuesday afternoon by Mr. W. W. Freeman, who pointed out in his address on broader ideas of commercial development that, while improvements in technical efficiency of apparatus have about reached their limits in the various departments of generation, transmission and distribution, the fullest development of the central-station industry in the future must take place in the commercial end of the business.

The various sessions of the accounting section were carried out as planned, and the papers were discussed with much enthusiasm.

The time of the second general session was taken up entirely by the report of the rate research committee and the interminable discussion which always attends any paper on rates.

PUBLIC POLICY SESSION.

A crowded house greeted the officers of the association at the public-policy meeting on Wednesday night, showing the increased interest which attends the reports of the most important committee of the association. It was expected that Governor Hay of Washington would be present to address the gathering, but at the last moment he sent a message regretting his inability to attend. The honor of reading the report was intrusted to Mr. Samuel Insull, who was greeted with prolonged applause. At the conclusion of the reading of the report and for the benefit of the people of Seattle present, Mr. Insull stated that the committee represented one-half of the money invested in the electric lighting and motor-service business in the United States, or approximately $1,000,000,000, so that its findings were worthy of very serious consideration. The cloud of social unrest which hovers over the country, he said, could best be dissipated by movements resulting in contented employees. Since savings funds encourage thrift and lead to the acquisition of property, Mr. Insull maintained that in fostering such movements the industry is performing a distinct service to the community and to the country at large. He advocated warmly, as heretofore, the concentration of production and distribution of electricity in the hands of a single corporation and welcomed the formation of public service commissions, claiming that only by this means can the incidental troubles from competition be eliminated in a business which from its very nature should be monopolistic. The speaker then reviewed very carefully the pleasant relations existing between the electric lighting industry and the manufacturers and to a great extent the banking interests.

In presenting the formal report of the medical commission on resuscitation from electric shock, Mr. W. C. L. Eglin reviewed the causes leading to the appointment of the joint committee, paying a high tribute to Mr. W. D. Weaver, of the *Electrical World*, for his indefatigable labors in bringing about the formation of such a commission. On motion of Mr. H. L. Doherty, a vote of thanks was extended to the American Medical Association, and the present committee was continued for another year.

Abstracts of the papers and complete reports of the discussions thereon will be given in our next issue.

MISSISSIPPI ELECTRIC ASSOCIATION CONVENTION.

As noted in our issue dated June 8, the fourth annual convention of the Mississippi Electric Association was held in Vicksburg on May 28, 29 and 30. The attendance was about the same as at last year's convention, a total of 106 being registered. At the opening session Vice-president R. B. Claggett, who explained that President J. Abbott would not be in attendance on account of his removal from the State, introduced the Hon. J. J. Hayes, Mayor of Vicksburg, who welcomed those in attendance. The remarks of Mayor Hayes were well received and Vice-president Claggett gracefully acknowledged them on behalf of the association. He then proceeded to read his address as acting president, in which he dwelt on the work of the past year. He stated that the "Question Box," as a means of activity for all the members, should be one of the important works of the association. Current questions can be handled to better advantage, useful data can be placed in hands of members, and its facilities will serve for communication between members. He expressed his conviction that it would become a great factor in the association. He expressed his thanks to the editor, Professor C. E. Reid, for his untiring efforts.

Speaking on standardization of accounts, he said that a committee should be appointed to consider the adaptability of the forms prescribed by the National Electric Light Association. If the time should come when member companies will be subject to rulings of a public utility commission they should be in position to convince its members of the practicability of the forms recommended. Regarding proposed legislation, he stated that the electrical industry had developed so rapidly that central-station managers have had no time to watch legislative matters, resulting in a condition which poorly protects the interests involved. A number of important laws should be enacted, among which is one dealing with the theft of energy which makes the presence on any premises of any appliance or other device for the purpose of deflecting the flow of energy prima facie evidence, thereby putting the burden of proof on the occupant of the premises. During the year the executive committee appeared before the judiciary committee of the State Senate and discussed thoroughly the merits and demerits of certain proposed legislation. The results achieved were beyond the committee's expectation. Had it not been for the concentrated effort on the part of the association the central stations of the State would, in all probability, be subject to rulings of a political commission whose members would be unfamiliar with the subjects in hand.

In his report as secretary-treasurer, Mr. A. H. Jones remarked that the conduct of the case before the Senate committee and the results obtained proved conclusively the value of the association as well as the absolute necessity of the organization. A committee was recommended to gather information and statistics on public utility commission matters and also to draw up a recommendation of a public utility bill, patterned after the best features of the laws of other states, so that the data and recommendations can be submitted to the Legislature when the subject becomes active again.

Affiliation with the National Electric Light Association was called to the attention of the members as well as the necessity for a change in membership classification to conform with the plan followed by the N. E. L. A. A reduction in revenue would result, but the individual members would gain.

A reception was tendered to members and guests at the Carroll Hotel Tuesday evening. This was a brilliant affair and much appreciated by the association. On Wednesday evening an address on "Public Relations" was delivered by Mr. Harold Almert in the Warren Street Theater. The speaker claimed that where the conditions of franchise are reasonable and the management of a public utility is progressive and conducts its business as a public trust the terms of its franchise matter little. On the other hand, if the management refuses to recognize the equity of the public and declines to be liberal and fair, that management will go down to merited defeat and financial loss, regardless of the most liberal franchise ever granted.

INDUCTION METERS.

Much interesting information was given relating to the development of induction meters, and the features of some of the present types were described in a paper by Mr. R. C. Lanphier, which was read by Mr. H. W. Young. All of the meters now on the market, except the Fort Wayne types, have aluminum-disk armatures varying in weight from 15.5 grams to 35.5 grams. The Fort Wayne meters have an aluminum cut type of armature. The torque in different makes of meters on the market varies from a minimum of 38 to a maximum above 75, and the shunt losses in the standard 60-cycle meters vary from 1.25 watts to a maximum of 2.75 watts. The loss in the series coil varies con-

siderably in different makes of meters. All modern meters have permanent damping magnets acting upon the armature so as to control the speed of rotation. For many years adjustment of the damping magnet was obtained in all meters by moving the permanent magnet in and out on the disk. In almost all of the new meters which have been put on the market during the past eighteen months speed adjustment is obtained by shunting more or less of the flux of the magnets away from the path through the retarding element of the meter, thereby varying the speed without actually changing the position of the permanent magnet.

The paper of Mr. Lanphier was discussed by Prof. C. E. Reid and Messrs. H. W. Young and A. H. Jones. Professor Reid dwelt on the sustained high accuracy of induction meters, citing some tests made at the Bureau of Standards at Washington a number of years ago. Mr. Young pointed out that the expiration of certain patents had opened the door to meter designers and the present lower price meters were the result. He stated that further reductions are not probable, that the central stations demand a high degree of accuracy and on this account the overhead charges of the manufacturers are high. Mr. Jones remarked that the consumer is jealous of the treatment received and nothing but a meter of the highest accuracy will satisfy him.

GROUNDED SECONDARIES.

Mr. J. T. Robertson presented a paper in which attention was called to various rulings which had been passed concerning the grounding of secondary circuits. He stated that at a meeting of the National Fire Protection Association to be held in March, 1913, it is probable that a ruling will be passed making mandatory the grounding of secondary circuits so that the maximum difference of tension between the grounded point and any other point on the circuit shall not exceed 150 volts. Mr. Robertson, who is the electrical inspector of the Mississippi Inspection & Advisory Rating Company, claimed that grounding is effective only to the extent that the ground connection is thorough. The best and most approved method of grounding is to make connection to the underground water-pipe system at close intervals with wire not smaller than No. 6 B. & S. gage copper. In case a water-pipe system is not available rods or pipes may be driven into the ground below the permanent moisture elevation, connection being made with these by means of wire of No. 6 or larger size.

Mr. Robertson's paper was discussed by Messrs. H. W. Young, C. E. Reid, S. M. Jones, T. B. Cabell, A. H. Jones, R. B. Claggett and W. H. Harvey. The discussion brought out the fact that the grounding of secondaries is a source of much worry to all of the companies. The expense of the ground connection, as well as the inspection, and the troubles from defective installations and grounds in trees were gone into thoroughly. Mr. Young pointed out that a spark-gap interposed in the ground circuit oftentimes avoids the troubles due to poorly insulated systems and protects the system from high voltage.

TRANSFORMER DETAILS.

The constructive features of certain lines of distributing transformers were described in a paper by Mr. A. D. Fishel, read by Mr. T. A. McDowell. Mention was made of the fact that transformers operating in parallel divide the load between them in inverse proportion to the relative local impedances of the transformers. With the standard distributing transformer provided with series-parallel connections on both the high-tension and the low-tension sides, the load may be divided equally between them by connecting the primary coils of the two transformers in series, the secondary coils being then connected in parallel. With the primary windings in series the current in these two coils will be equal and hence the two secondary currents will be equal. Perhaps the most important single element in a transformer is its insulation. Excellent results have been obtained in this connection by using a continuous barrier of high dielectric strength as a shield between the high-tension and the low-tension windings. This shield is not readily subject to mechanical injury. One of the serious enemies of insulation is moisture, and special provisions must be made for keeping it away from the windings. The main opening for possible entrance of moisture in the transformer is in the joint between the case and the cover. This is usually filled with a felt gasket. The pockets through which are brought out the leads from the transformers are filled with an oil-proof, moisture-proof sealing compound. This paper was briefly discussed by Messrs. H. W. Young, W. F. Cox, A. H. Jones and W. F. Gorenflo.

ELECTRIC SERVICE RATES.

An outline of the general theory upon which electric service rates are based was given in a paper read by Mr. G. S. Merrill. He showed that the total cost can be divided into two parts—a fixed and a running. The fixed cost, expressed as so much per kilowatt, depends upon the amount of power. The running cost, at so much a kilowatt-hour, depends upon the amount of energy consumption a month. An outline was given of the method of charging for residence lighting according to the number of active rooms. As an example, there would be a primary charge of 12 cents per kw-hr. for the first 4 kw-hr. consumed per month for each of the first four active rooms and for the first 2.5 kw-hr. consumed per month for each of the active rooms in addition to the first four. There would be also a secondary charge of 5 cents per kw-hr. for all energy in excess of that paid for at the primary rate up to a total of 100 kw-hr., and 4 cents per kw-hr. for the next 900 kw-hr. Attention was called to the advantages of employing a flat rate in many cases.

The paper by Mr. Merrill proved to be one of the most interesting presented during the convention. It was discussed by Messrs. T. J. Duffy, John S. Black, C. E. Reid, P. Stern, W. H. Sparrow, W. F. Gorenflo, A. H. Jones and S. M. Jones. Mr. Duffy expressed the opinion that it would be difficult to explain a multiple-rate system to customers. Mr. Black cited his personal experience as satisfactory in New Orleans, where the change had recently been made from the straight kilowatt-hour charge to multiple rate. Mr. Gorenflo thought the only excuse for the straight kilowatt-hour rate is its simplicity and doubted success with any other, especially where many foreigners are customers. Professor Reid cited a personal experience with a similar rate. Mr. S. M. Jones asked for a rate which would permit the use of electric cooking appliances on a lighting meter. Mr. A. H. Jones suggested a rate of such flexibility that it would be adaptable to all conditions and pointed out that such a rate could be offered as an option to customers who complain or are dissatisfied with old rates. Gradually the new rate would attract attention and win favor and eventually permit the discontinuance of the old rate.

An illustrated paper on "Modern Street Car Construction for Small Cities" was presented by Messrs. George L. Kippenberger and W. L. Alt, of the St. Louis Car Company. The paper was very elaborate and entered into considerable detail. It was discussed by Messrs. A. J. Carter, W. B. Moorman, I. H. McArthur and the authors.

MIXED-PRESSURE AND LOW-PRESSURE TURBINES.

In a paper by Mr. H. F. Bussey were presented arguments to show why the steam turbine possesses marked advantages over a reciprocating engine for low-pressure service. The physical dimensions of a low-pressure turbine to handle a given quantity of steam are much less than those of the low-pressure engine because the velocity at which the steam travels through the turbine is much greater than that in a reciprocating engine. In a turbine the steam

passes from one stage to the next at the spouting velocity of the steam due to its pressure in the nozzle-throat in relation to the pressure in its succeeding stage. The mixed-pressure turbine is one embodying a combination of high pressure and low pressure. When use is made of such a machine and low-pressure steam is not available on account of some emergency condition it is possible to run the machine as a high-pressure unit carrying full load at steam consumptions comparing favorably with that of a high-pressure unit. The high-pressure feature of a mixed-pressure unit does not complicate the turbine because the steam is expended on the same wheel which utilizes the low pressure, and the same controlling device and governor operate on both the high-pressure and the low-pressure steam. An advantage of the mixed-pressure turbine over the low-pressure turbine supplied with high-pressure steam through a reducing valve is found in the fact that the machine will carry a certain proportion of its load on high-pressure steam while operating non-condensing. This paper was discussed briefly by Messrs. W. F. Cox, F. L. Bailey, E. J. Lenz, W. F. Gorenflo, H. W. Young and H. Almert.

HAND-FIRED AND MECHANICALLY FIRED COAL.

The proper method for placing coal upon the bed of a boiler furnace in order to extract the highest number of heat units was described briefly in a paper by Mr. W. F. Gorenflo. He stated that the recognized requirements are a uniform and continuous supply of fuel to the furnace, an air supply slightly in excess of the theoretical amount required for complete combustion, temperature sufficiently high to ignite the gases that are driven off from the fuel, and a complete mixture of these gases with the air supply before they reach the boiler shell or tubes. In order to obtain this result the human element must be eliminated and the work must be done automatically. The mechanical stokers on the market to-day show much better result than hand firing because they reduce greatly the cost of handling the coal from the bunkers to the furnace doors. In a plant using a small amount of coal, where it is necessary to have only one fireman a day, it is questionable whether or not it would be good policy to install mechanical stokers. Wherever two or more firemen are required it would be well for the operator to investigate the merits of a stoker which will burn slack coal and decrease the expense of getting it into the furnace. The discussion was participated in by Messrs. H. Almert, H. W. Young, W. F. Cox, F. J. Bailey and W. B. Moorman.

PUBLIC SERVICE COMMISSION NEWS.

NEW YORK COMMISSION.

The Public Service Commission of the First District has approved the assignment of the contract for the construction of Section 13 of the Broadway-Lexington Avenue subway by the Bradley Contracting Company to McMullen, Snare & Triest, Incorporated. Arthur McMullen, of the latter company, was the successful bidder for the construction of Section 14 of this subway. As Section 13 joins it immediately on the south, Mr. McMullen considered that it would be to his advantage to carry on the work on both sections and accordingly procured the assignment of the contract from the Bradley Contracting Company. Section 13 lies in Lexington Avenue between 118th Street and 129th Street, and the bid of the Bradley Contracting Company for its construction was $4,071,416.50. Mr. McMullen's bid for Section 14 was $3,889,775.05.

The Public Service Commission of the Second District has issued an order approving certain types of direct-current commutator and mercury motor meters, described in detail in one of its recent circulars. The meters approved are the following: Duncan Model E two-wire commutator meter; General Electric Type C, C-6, C-7, two-wire commutator meters; Sangamo Types D, D-4, two-wire mercury motor meters; Westinghouse direct-current two-wire commutator meter; Willis straight-line two-wire commutator meter. The approval of the commission applies only for the use of these meters in the measurement of energy in direct-current, constant-potential circuits, and provides that the manufacturers' type delegations shall be understood to apply only to meters conforming in design and construction to samples of such meters kept by the commission as records of the types.

WISCONSIN COMMISSION.

The Madison Gas & Electric Company has applied to the commission for an order nullifying an ordinance recently passed by the new Common Council, according to the terms of which the company is required to remove its poles from certain designated streets which are about to be improved. The company contends that the old Council passed a resolution approving certain proposed alterations designed to reduce the number of poles on the affected streets and otherwise to improve their appearance. The petition sets forth that it would be impracticable to furnish lighting service from poles on near-by streets and that the cost of placing the wires underground would be unduly high. Furthermore, inasmuch as the company has been compelled within a year to incur a very heavy expense in the business district of the city by reason of required underground construction, it is unreasonable and arbitrary to require this additional expenditure in a purely residence district.

No date has been set by the commission for the hearing on the complaint. A favorable decision would not be without precedent, as the commission has recently declared invalid certain ordinances passed by the Common Council of Beloit relating to the extension of water mains, on the ground that they were unreasonable.

A hearing has been held upon the application of the Burlington Light & Power Company for authority to increase its rates. The company at present offers a flat rate of 10 cents per kw-hr. with no minimum charge and with free lamp renewals. The company has in effect a so-called minimum charge which is in reality a meter rental charged consumers who do not own their own meters. This practice, however, is contrary to the provisions of the public utility law. The petition prays for an order fixing a uniform minimum bill at 75 cents per month and providing for such alterations in the present schedule as the commission may see fit to make.

INDIANA COMMISSION.

Judge Anderson, of the federal court, has approved the report of Special Master Butler in a suit brought by the Indiana Railroad Commission against the Baltimore & Ohio and other railroads in Indiana to compel them to install and use on their locomotives 1500-cp head-lamps. In accordance with the finding of Mr. Butler, the court held the order of the commission void, because it was not clear and specific. The commission has the power to require the railroads to obtain a stronger head-lamp, but another modified order must be issued by the commission before it will be held legal. Judge Anderson overruled the exceptions to the report.

NEW HAMPSHIRE COMMISSION.

The Public Service Commission of New Hampshire has granted the Keene Gas & Electric Company permission to build a high-tension transmission line from Keene to Chesterfield across the Tierny property and has awarded damages to the Tierny interests.

The commission has ordered the Boston & Maine Railroad Company to provide additional trains on the Portland division experimentally for six months.

Current News and Notes

Long-Distance Wireless Music.—According to reports from Paris, music has been transmitted wirelessly over a distance of more than 400 miles from Fort de Leau in Algeria to the ship *Hirondelle* in the inner harbor of Toulin. The experiments were carried on in the daytime. The receiving apparatus included a mast on the ship only 120 ft. in height.

* * *

Maximum Indicator and Watt-Hour Meter.—A patent, No. 1,028,715, was granted to Mr. Chester T. Hall, of Chicago, on June 4, 1912, on a watt-hour meter with which is associated a maximum indicating device, the advancement of which is controlled by the watt-hour-meter mechanism in accordance with the consumption of electrical energy measured by this meter. The meter measures the total amount of energy consumed and also records the maximum energy consumption during any predetermined period, for instance, five minutes. The indicator remains at the highest position to which it may have been driven during any five-minute period until the end of the month, when the meter reader returns the indicator to its zero position. This meter is to be used in cases where the charge for energy is based partly upon the total consumption and partly upon the maximum demand during a certain period. The patent has been assigned to the Minerallac Electric Company, of Chicago.

* * *

Transatlantic Wireless Service.—The Marconi Wireless Telegraph Company of America, in accordance with announcements made by it a short time ago, during negotiations for acquisition of the United Wireless Company, that a station would be erected near New York for direct communication with England, has purchased a tract of 550 acres near Belmar, N. J., on the Shark River, upon which a station for transatlantic service will be built immediately. This will be one of the largest commercial stations in existence, not an experimental station, as was intimated last week in these columns, in which it was erroneously stated that the company had purchased a site near Port Monmouth, N. J. The company hopes to have the new station in readiness by June 1, 1913, to operate in conjunction with a station now being erected near London by the Marconi Wireless Telegraph Company, Ltd. Options have been obtained by the American company on the Pacific Coast on tracts upon which stations for communication with Hawaii and the Philippines will be erected.

* * *

SOCIETY MEETINGS.

Schenectady Section, A. I. E. E.—The annual dinner of the Schenectady Section of the American Institute of Electrical Engineers will be held at the Mohawk Golf Club on Thursday, June 20, at 7:30 p. m. The price of the dinner has been placed at $1.35. The secretary of the section is Mr. Chester Lichtenberg.

* * *

Rejuvenation.—A rejuvenation of the Sons of Jove will be held at Chicago on June 28 in the Louis XVI room of the Sherman Hotel under the direction of Statesman J. H. Delany. During the evening a banquet will be given at the hotel. This banquet and accompanying entertainment will be in charge of Tenth Vulcan George H. Porter.

* * *

New England Section, I. E. S.—The annual meeting of the New England Section of the Illuminating Engineering Society for the election of officers took place on June 10. At this meeting a paper entitled "A Symposium on Direct, Indirect and Semi-Indirect Lighting" was presented by Messrs. H. T. Spaulding, of Cleveland, and S. G. Hibben, of Pittsburgh. The following officers were elected: Chairman, Mr. R. B. Hussey; secretary, Mr. H. C. Jones; managers, Messrs. H. E. Clifford, C. A. B. Halvorson, J. M. Riley, R. C. Ware and W. C. Wickenden.

* * *

St. Louis Company Section, N. E. L. A.—At a meeting of the Union Electric Light & Power Company Section of the N. E. L. A. held at the City Club, St. Louis, on May 31, Mr. J. E. Hillemeyer presented a paper entitled "Development of the Electrical Industry in St. Louis County," and Mr. H. G. Kislingbury read a paper entitled "The Hollerith Tabulating Machine and Its Uses by the Union Electric Light & Power Company."

* * *

Annual Meeting of the New York Electrical Society.—At a meeting of the New York Electrical Society on June 12 the following officers were elected: President, Mr. H. L. Doherty; vice-presidents, Messrs. A. L. Doremus, Frank W. White and Edward C. Titus; secretary, Mr. George H. Guy; treasurer, Mr. Herbert S. Spencer. Mr. Augustus Post delivered a lecture on his experiences in ballooning, and Mr. L. L. Ovington lectured on aeroplane wireless and the problem of the modern flying-machine.

* * *

New York Company Section, N. E. L. A.—At a meeting of the New York Company Section of the National Electric Light Association, to be held on June 17, a series of ten-minute papers will be read relating to the general subject of heating appliances. These papers will be presented by Messrs. Rodger Williams, B. C. Sprague and H. M. Wilson. There will also be ten-minute lectures on heating appliances and the best methods for their sale. These papers have been prepared by Messrs. D. B. Smith and W. L. Secord and Miss M. Keinz. The executive secretary of the section is Mr. F. C. Henderschott, 1170 Broadway, New York.

* * *

The Pennsylvania Electric Association.—In our issue of May 25, in an item relating to the annual convention of the Pennsylvania Electric Association, which will be held at Bedford Springs, Pa., on Sept. 4, 5 and 6, it was stated that Mr. Thomas Sproule is secretary of the association. The secretary is Mr. Walter E. Long, 1000 Chestnut Street, Philadelphia. Mr. Sproule is chairman of the program committee and has been highly successful in obtaining the papers for the convention. During the convention Dr. C. A. Lauffer, of the medical department of the Westinghouse Electric & Manufacturing Company, will present a paper on "Resuscitation from Electric Shock," accompanied by a demonstration of the Schaefer method of resuscitation by means of prone pressure, which has been indorsed by the commission that has recently investigated the subject.

* * *

Institute of Radio Engineers.—The third meeting of the Institute of Radio Engineers was held at Columbia University, New York, on June 3, President R. H. Marriott presiding. Fourteen new members were elected, the standardization committee was enlarged and a committee was appointed to submit designs for a new emblem, which might symbolize the consolidation of the society of Wireless Telegraph Engineers and the Wireless Institute. The selection of Messrs. R. H. Marriott and J. L. Hogan, Jr., by the American Institute of Electrical Engineers as representatives of the Institute of Radio Engineers upon the organization committee for the International Electrical Congress at San Francisco in 1915 was announced. Mr. Lesh informally addressed the Institute on "Radio Signaling in Aviation," pointing out that the sooner the problems of such communication are solved the sooner the aeroplane will come into its full use. Various forms of antenna construction were discussed, and it was noted that the advent of the silent aeronautical motor is greatly aiding the use of receiving instruments aboard aeroplanes. The next meeting was set for September.

EXTENSION OF THE REDONDO STATION OF THE PACIFIC LIGHT & POWER CO.

Addition to Boiler Plant and Remodeling of Condenser Circulating-Water System to Secure Service Reliability.

Installation of 30,000 kva in Steam-Turbine Units in Generating Station Without Enlarging Engine-Room or Displacing Original Prime Movers.

ONE of the most noteworthy electric generating plants in California is the Redondo station of the Pacific Light & Power Company, located at Redondo Beach, on the shores of the Pacific Ocean, about 18 miles southwest of the rapidly growing city of Los Angeles. The original plant was described in this journal on Sept. 12, 1908, page 569, the station being remarkable for its use of double vertical and horizontal reciprocating engine units and for the extremely high fuel economy attained in its operation. When burning fuel oil in the furnaces of its water-tube boilers, the plant produced, in a fifteen-day run, 252.8 kw-hr. per barrel of oil, the barrel weighing filled 334 lb. and each pound containing 18,500 lb. Fahr. thermal units. This economy has been well maintained on the whole since the foregoing acceptance test on the station was made. The station furnishes energy for the operation of a large portion of the interurban trolley system of the Pacific Electric Railway Company and the street-railway service of Los Angeles, in conjunction with the Kern River and other hydroelectric plants by which the Pacific Light & Power Company supplies electricity throughout its extensive territory.

The original station contained three 5000-kw, three-phase, 18,000-volt, 50-cycle generators directly driven by three 34-in. by 70-in. by 56-in. combined double horizontal and vertical, compound, side-crank McIntosh & Seymour automatic gridiron valve engines, running at 100 r.p.m. upon 175 lb. steam pressure and at 100 deg. Fahr. superheat. Each engine was installed with two Wheeler "Admiralty" surface condensers, each being equipped with an Edwards vertical triplex air pump driven by a 25-hp induction motor. The steam-generating equipment consisted of eighteen Babcock & Wilcox boilers equipped with Peabody oil-burning furnaces, with three burners per boiler. Each boiler has a total heating surface of 6042 sq. ft., and the natural draft for the operation of the plant was supplied by two reinforced-concrete chimneys, each 13 ft. in diameter and 125 ft. high.

The intensely rapid development of the city of Los Angeles and its suburbs since the completion of the plant about four years ago necessitated the early enlargement of the Pacific company's generating facilities both in connection with the hydroelectric plants in the mountainous regions of the State and in relation to auxiliary capacity. High-pressure steam turbines were selected for the enlargement of the Redondo station instead of low-pressure machines on account of the quicker deliveries available, coupled with the fact that with the high-pressure units no alterations of engine cylinder ratios were necessary. Two 15,000-kva, three-phase, 9000-volt General Electric alternators directly driven by Curtis vertical turbines at 750 r.p.m. were therefore installed in the original engine-room upon foundations erected on the site of a former pump pit. The

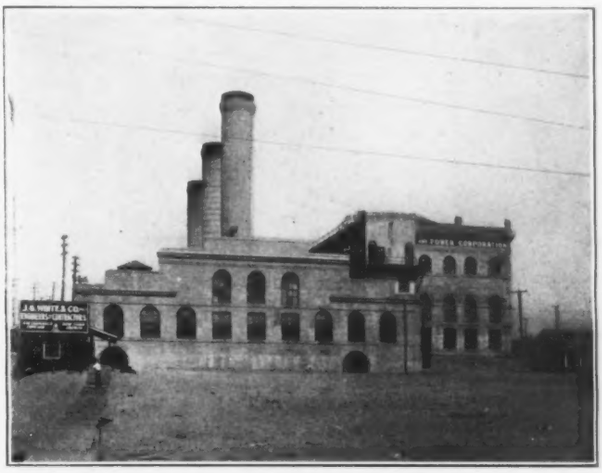


Fig. 2—Extended Boiler-Room and Switch Compartment of the Redondo Station.

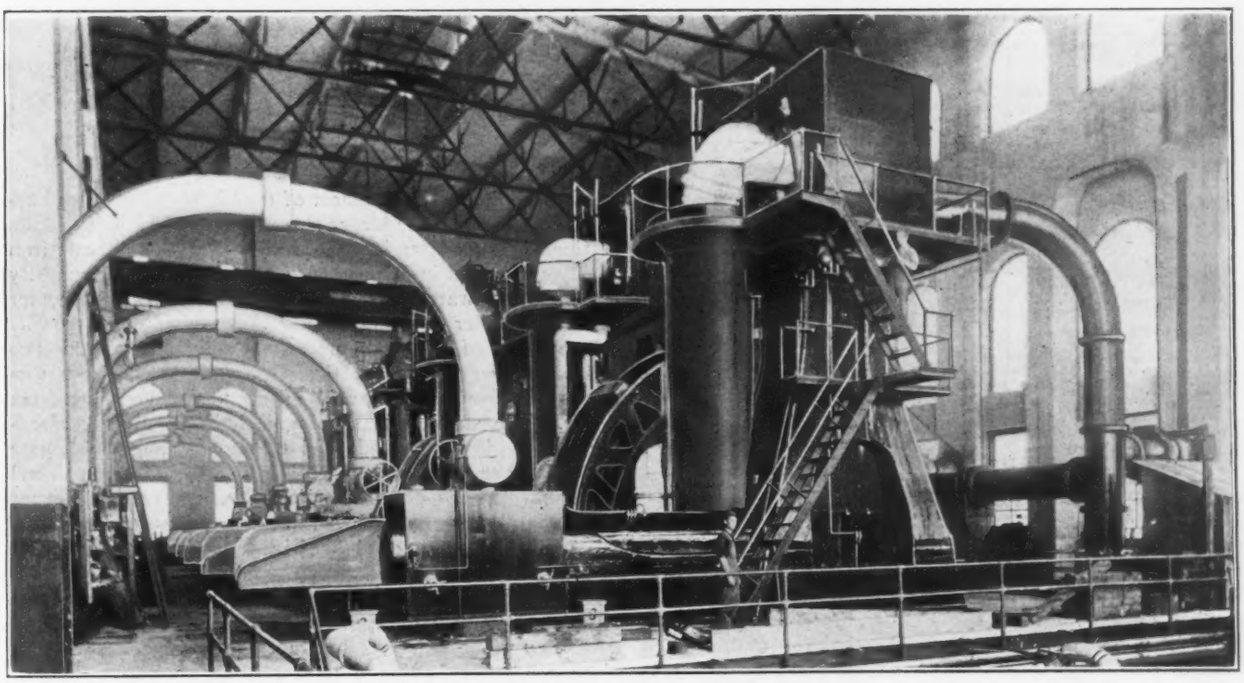


Fig. 1—Main Generating Room at Redondo Station.

size of the room was unchanged, and in this case a total nominal equipment rating of 40,000 kw in engine and turbine units is located in an area 200 ft. long by 80 ft. in width. The original boiler-room was 160 ft. by 130 ft. in dimensions. To provide the steam required by the two new units, eighteen Stirling boilers each rated at 602 hp were installed, with a third reinforced-concrete stack of the

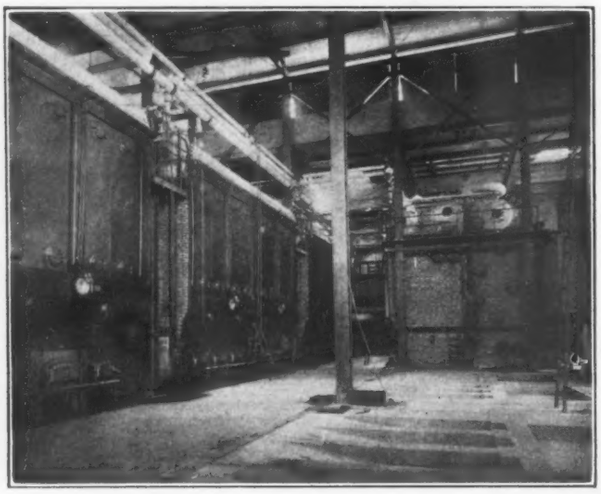


Fig. 3—New Boiler Installation.

same dimensions as the two original stacks. To house the additional equipment, the boiler-room was extended about 131 ft. by 107 ft. The general plans of the enlargement and the construction work incidental to it were carried out under the direction of J. G. White & Company, of New York.

The completed boiler-room contains thirty-six boilers arranged in six parallel rows, with four firing aisles running parallel to the axes of the reciprocating-engine units. Each boiler is provided with a Babcock & Wilcox superheater capable of raising the steam temperature 100 deg. Fahr. above that normal to its pressure—190 lb. per square inch. Three Hammel back-shot fuel-oil burners are used under each boiler, the burners being hand-regulated. Automatic regulation of burners is utilized in connection with

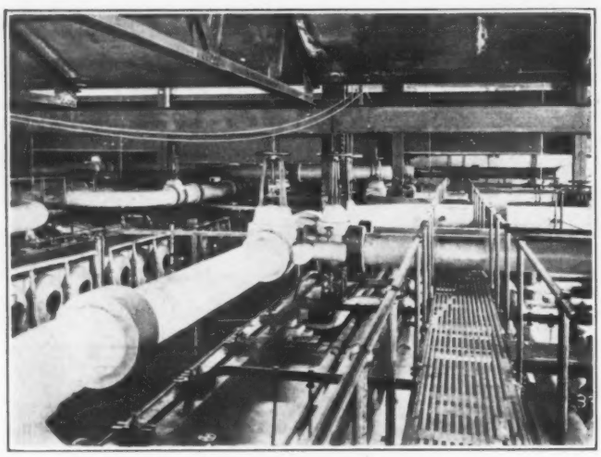


Fig. 4—Steam Piping.

the original boiler installation, which carries the fluctuations in the load. The supply of feed water for the boiler plant is drawn from wells driven near a lake situated about a quarter of a mile from the station, there being an 8-in. connection between the wells and a storage tank located outside the power house, from which make-up water is taken as required. All feed water is purified.

Special care was taken to provide a piping installation of the utmost reliability, in view of the large number and variety of services required in the plant. Included under high-pressure systems are all steam piping, steam drip lines, boiler feed, blow-off and cleaning lines, steam piping for oil burners and discharge lines for the oil step bearings and guide-pump bearings. All the steam piping was designed for operation at 200 lb. pressure and at 150 deg. Fahr. superheat, and with the exception of the step-bearing piping was tested at 400 lb. per square inch, the latter being tested at 1500 lb. All sizes of steel pipe above 4 in. diameter were equipped with Van Stone flanges of forged steel, gaskets being of corrugated steel on account of the superheat employed. Long-radius bends take care of expansion and contraction in the main steam piping, slip joints being used on the smaller steam services. In general, 8-in. risers deliver the steam from the boilers into 15-in. headers, from which each turbine is served by a 15-in. high-pressure line carried up from the basement of the engine-room to a T-connection supplying steam to the turbine stages. Steel boiler-feed piping was used in the original plant, but high depreciation resulted, and in the new work cast-iron piping is employed.

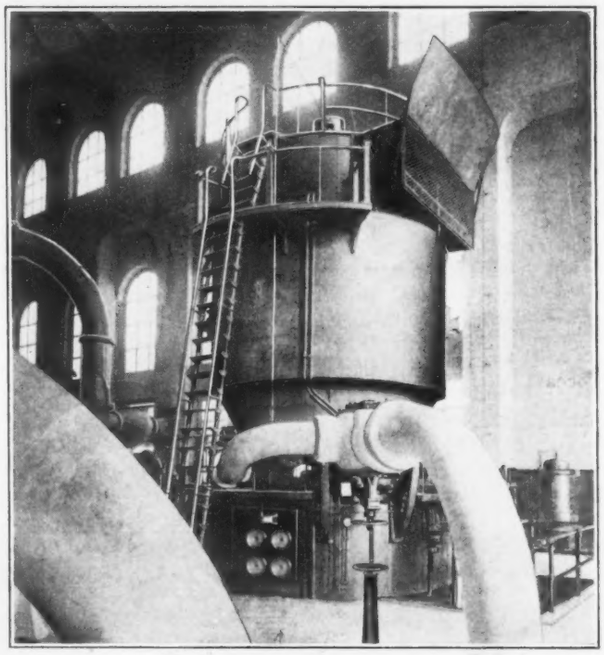


Fig. 5—15,000-kva Turbine at Redondo.

Steel piping is used in most of the high-pressure and low-pressure services, the larger steam valves and flanged steam fittings being of semi-steel. Bronze valves and cast-iron fittings are used in connection with the smaller piping. By means of separate connections for carrying away the water used for boiler washing danger of burning employees by the opening of a blow-off on a live boiler is avoided. The oil piping serving the vertical guide bearings of the turbines is galvanized to avoid injury to the bearings from scale. The step-bearing piping is built of double, extra-heavy seamless annealed steel tubing, equipped with gate valves of the high-head type. Use is made of riveted steel atmospheric exhaust pipes. Wainwright corrugated copper expansion joints are employed in the low-pressure lines, and all pumps are controlled by Fisher automatic regulators. The Crane Company, Chicago, supplied the greater part of the valves, and the piping system was supplied by Braun, Williams & Company, San Francisco.

Each turbine exhausts into a two-section Alberger surface condenser having a total cooling surface of 24,000 sq. ft., the main condenser being located in the turbine

base. The condensate is handled by two 5-in. centrifugal pumps from the main base condenser to the hot-well, and each condenser is provided with a 10-in. by 30-in. by 24-in. Alberger dry-vacuum pump. An auxiliary hot-well is located in the boiler house, from which water is pumped to two 10,000-hp Cochrane vertical feed-water heaters and purifiers prior to boiler delivery. One of the most striking

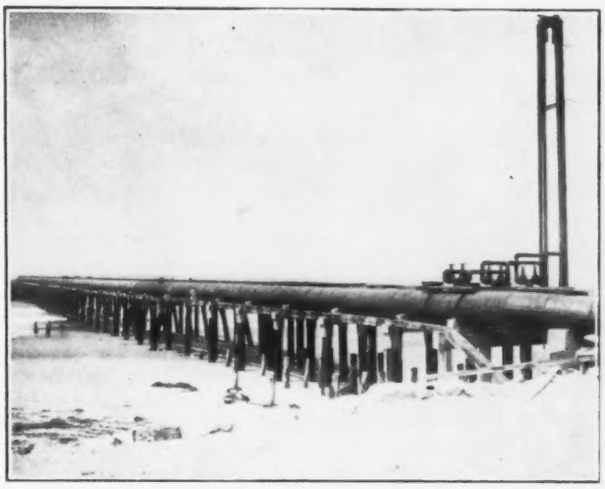


Fig. 6—Condensing Water Intakes.

features of the plant is the circulating-water system for condenser service. The maintenance of a high vacuum is of much greater importance in the operation of a turbine than it is in handling a steam-engine plant, on account of the fact that with the former 50 per cent of the load is carried in expansion below atmosphere pressure, while with the latter only about 25 per cent of the output is so carried. The original installation for circulating-water supply consisted of two 50-in. steel pipes running directly from the ocean to the power house, the circulating pumps being located in the engine-room. Serious trouble was encountered from seaweed, and when it was decided to extend the plant the system was remodeled along the following lines:

A reinforced concrete pier 950 ft. long extends into the

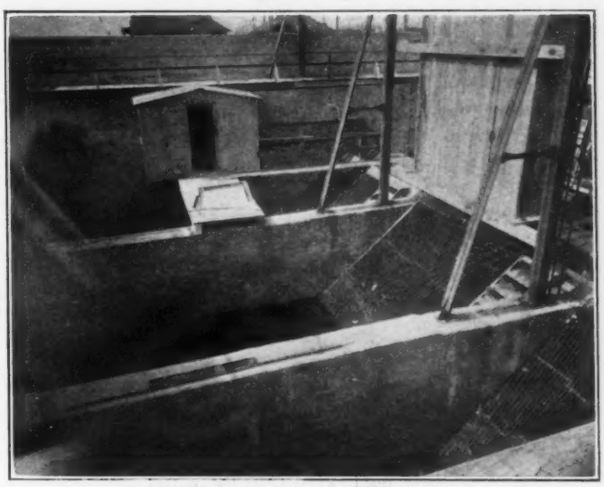


Fig. 7—Detail of Screen Chamber.

ocean and three 54-in. siphon pipes of steel were laid upon it and connected at the shore end to a screen basin of reinforced concrete from which short suction lines lead to a pump house containing three 30-in. Price double-suction centrifugal pumps, each designed to deliver 24,000 gal. of sea water per minute against a total head of 40 ft. when operating at 225 r.p.m. and consuming about 350 hp. The pump intake is 32 in. in diameter and the discharge is 30 in. in diameter. Each pump is directly coupled to a 16-in. by 27-in. by 18-in. Harrisburg side-crank engine provided with a Gardner throttling governor. These engines were furnished by Charles C. Moore & Company, San Francisco, engineers of the original installation at Redondo. Three 42-in. pipes run from the pump house to the condensers

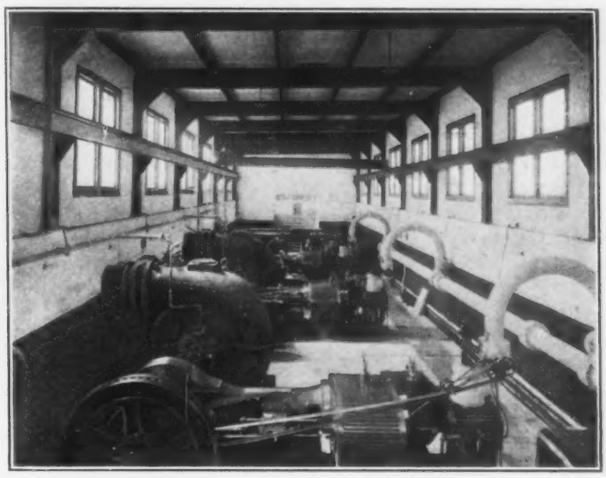


Fig. 8—New Circulating Pump House.

in the power plant, and these lines are cross-connected by a manifold 26 in. in diameter and 13.5 ft. long outside the pumps. The incoming lines from the ocean are equipped with air discharge outlets at the shore end. The screen basin is divided into three bays and is equipped with 7/8-in. to 1/2-in. mesh screens, inclined racks, a 6-in. motor-driven sand pump, water flushing pump connection, and an electric traveling crane for raising and lowering screens or racks. The screen chamber is 58 ft. long by 52 ft. wide. The siphon suction is started and maintained by three air compressors located in the pump house, and tests show that this suction will hold automatically for about two hours after the compressors are shut down. The pump house is 90 ft. long by 30 ft. wide and is located near the edge of the beach and

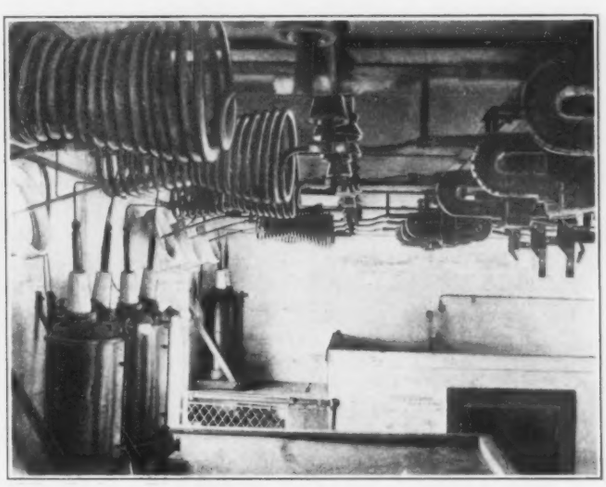


Fig. 9—Outgoing 18,000-Volt Feeder.

about 300 ft. west of the power plant. The suction lines terminate at the ocean end of the pier in seven 26-in. suction nozzles 22 ft. long which extend into deep water. The velocity of the water is low as it enters the intake nozzles, so that much less seaweed is drawn in than where high velocities are utilized.

Between the pump house and the power plant the circu-

lating-water pipes consist of reinforced-concrete channels 54 in. in diameter cut in a reinforced-concrete casing 17 ft. long and 62 in. high, the whole being located underground. The salt-water discharge from the condensing system is also carried away from the plant in an underground conduit 5 ft. square and delivered to the sea at a distance of about 1000 ft. from the intake.

The turbo-alternators deliver energy at 9000 volts to single-phase auto-transformers of the Y-connected, water-cooled type, located in fireproof compartments at one side of the operating room. The auto-transformers raise the potential to 18,000 volts and connect through non-automatic oil switches to selector switches by which either generator may be connected to either of the two sets of operating busbars in the station. The old and new sections of the plant are provided with separate bus sections tied together by disconnecting knife and oil switches. Twenty-four 18,000-volt feeder circuits leave the station for the various load centers of the system, each line being extended out of the plant through insulating bushings about 24 in. in diameter, with the usual choke-coil and lightning-arrester connections. Any feeder may be connected to either bus. All of the oil switches in the plant are of the pantograph type and were manufactured by the Kelman Electric & Manufacturing Company, of Los Angeles, Cal. All of the line switches are of the automatic type and are for the most part set to operate at 1000 amp. The switchboard and high-tension switching apparatus are mounted in a gallery running the length of the building and above the operating room, between that and the boiler-room. The latest apparatus consists of twenty slate panels and a benchboard installation with Westinghouse remote-control equipment. Five generator panels, ten feeder panels, four blanks and an auxiliary apparatus panel are included. Energy for the operation of the remote-control apparatus is drawn from a storage battery. The generator field and exciter switches are operated by air valves, with duplicate control stands on the engine-room floor. Watt-hour meters are located in all generator and feeder circuits and are mounted on a separate panelboard in the switchboard gallery. Main and auxiliary exciter buses are provided. An emergency oil switch is provided in each generator phase in the operating room which may be opened in case of trouble in any of the oil switches in the gallery. Pilot lamps are installed to show whether the excitation energy for the generator field circuits is being taken from the main or auxiliary busbars, and each generator circuit is provided with a voltmeter calibrated to read directly in terms of line voltage. The oil switches are for the most part located in a compartment above the operating switchboard room, and a motor-driven hoist is installed on a platform outside the switch divisions to faciliate handling heavy parts to and from the ground below.

ELECTRIC MINE PUMPING FROM 1600-FT. LEVEL.

The deepest electric mine-pumping equipment ever installed in Colorado is now being placed in the Golden Cycle Mine at Cripple Creek, where duplicate sets of 175-hp, 30-cycle, 2300-volt motors will drive triplex pumps at the 1600-ft. level, each pump lifting to the surface 400 gal. of water per minute. The motors are of the two-speed type, enabling the quantity of water delivered to be varied to meet the requirements of mine flow. These pump units will operate almost continuously, taking energy at 85 per cent load-factor on a twenty-four-hour basis. Steam for the steam pumps formerly used had to be piped nearly 2000 ft. to reach the pump level, entailing large condensation losses. The new electric pumps, according to Mr. F. P. Wood, engineer for the Arkansas Valley Light, Power & Traction Company, which furnishes the service, will in fifteen months save their own cost over the expense of steam operation. In the Cripple Creek gold-mining district the practice of placing large primary motors underground is increasing. The 2300-volt cables are carried down the shaft in conduit, being passed through switches at each 200-ft. level, where clamp supports are also provided to carry the weight of the depending cable. The great Roosevelt Tunnel, recently completed at a cost of $1,000,000, drains by gravity most of the mines in the Cripple Creek section except the Golden Cycle and an adjoining mine, which are cut off by a volcanic dike from the tunnel underground drainage. This necessitates the use of artificial pumping in the case of the mines last mentioned.

THE WILLISTON AND THE BUFORD-TRENTON ELECTRIC IRRIGATION PROJECTS.

The Transmission of Energy Directly from Lignite Coal Mines for Irrigation Pumping.

By C. P. Eldred.

THE Williston and Buford-Trenton irrigation systems are located on the Missouri River in western North Dakota. The total area of the two systems is about 25,000 acres. In 1907 construction work was carried on to irrigate 8000 acres at Williston and 4000 acres at Buford. The average elevation of the irrigable area is about 1900 ft. above sea level, the average annual rainfall is 13 in., and the range of temperature is from 49 deg. to 107 deg. Fahr. It is impossible to employ the usual gravity system to place the water upon the land, as the character of the riverbed will not permit the erection of a dam, and hence water is obtained by pumping from the Missouri River. At present there are 9 miles of canals designed for from 50 cu. ft. to 300 cu. ft. per second and 96 miles for less than 50 cu. ft. per second.

The plan of the Williston project provides for a central steam-turbine power plant operating three pumps and generating electricity for the operation of three outlying stations and also for the two stations at Buford.

The intake pumping barge on the Missouri River at Williston lifts the water 30 ft. into a settling basin, where much of the silt carried by the river is deposited. The water flows directly into the main canal up the Little Muddy Valley toward the power house, which is about 3 miles from the river. One mile from the river is located Pumping Station No. 2, containing two electrically operated pumps having a 28-ft. lift. A portion of the water from the station is lifted for the third time an additional 34 ft. at Pumping Station No. 4, containing one electrically operated pump. At the power house the water from the main canal is lifted by three steam-driven pumps. Two of these pumps lift water 56 ft. into the main, or E line, canal, which extends up the valley for about 7 miles, while the third pump lifts water 28 ft. into the smaller D line canal.

At Buford there is a barge intake station on the Missouri River, which lifts water under a 30-ft. head into a large settling basin, from which the proposed low-line canal will directly flow. A second pumping station situated at the northerly end of the basin contains four electrically operated pumps which lift the water under a 50-ft. head into the main, or A line, canal.

Coal for the boilers is obtained from a three-vein layer of lignite at the power house. Each vein is about 9 ft. thick, and the veins are separated by about 50 ft. of intervening clay. With proper development, it is possible to mine about 1000 tons of coal per acre-foot of vein, and there is an ample supply of coal to run the plant for an indefinite period. The mine is owned and operated by the government, the miners being paid by the ton of coal mined and loaded into cars. The coal is hauled by mules to the crusher at the

power house. The crusher was made by the Jeffry Manufacturing Company and handles 12 tons of coal per hour. It is driven by a Fairbanks-Morse 20-hp induction motor running at 1200 r.p.m. and taking energy at 220 volts. From the crusher the coal passes to an inclined conveyor, which takes it to the screw conveyor above the coal bunkers. The inclined conveyor is of the Jeffry type, while the 9-in. screw conveyor is of Willis manufacture. The screw conveyor is rated at 5 tons of coal per hour, but it is not necessary for all the coal to pass through it before reaching the bunkers. Each conveyor is driven by 10-hp Western Electric induction motors running at 1145 r.p.m. and receiving energy at 220 volts. A storage trestle for coal is located on a spur track between the mine and the power house and is designed to aid the mine at any time when an unusual amount of coal is required.

Fig. 1—Pumping Station and Camp at Buford, N. D.

Eight Sterling water-tube boilers are in use at the power house. The boilers are arranged in batteries of two, and each boiler contains 2580 sq. ft. of heating surface and is rated at 258 hp. The working pressure is 150 lb. per square inch.

The furnaces are of the Sterling semi-gas producing type and are designed for burning lignite coal. They consist of Dutch ovens with extended sloping firebrick arches, the grates for which are located at approximately the floor line, and are of the shaking air-cooled type, so arranged that a bed of fire from 18 in. to 20 in. thick can be regularly carried. The draft pressure in the ashpit is produced by steam blowers connected by piping to the boilers. Through openings in the furnace arch heated air is forced into the furnace gas, supplying the oxygen necessary for the combustion of the combustible gases distilled from the coal. The auxiliary air supply admitted over the fire is furnished by two 5½-ft. by 3¾-ft. housed steel-plate fans directly connected to engines, each fan being designed to handle 33,000 cu. ft. of air per minute against 1.5-ounce pressure. The air supply from the fans passes through air heaters placed in the rear of the boilers between the damper box and the third bank of tubes. Each air heater is made up of 750 ft. of 3-in. tubing, and the hot air is conducted by an external duct to the hollow bridge wall and from there passes through the hollow walls of the furnace to be heated further before it intermingles with the furnace gases. There is one 54-in. steel stack to each battery. Three of the stacks are 155 ft. high and the fourth is 130 ft. high.

The equivalent evaporation of these boilers is about 7 lb. of water from and at 212 deg. Fahr. per pound of dry fuel. The dry coal contains about 11,000 heat units per lb., and when first mined about 40 per cent moisture is present. During the past summer 25 per cent overload was carried on five of the boilers for short periods of time with comparative ease and with no evidences of unusual deterioration of the boiler setting or the water tubes.

The two boiler-feed pumps were built by the Jeanesville Iron Works Company. Exhaust steam from the auxiliary engines is utilized in a feed-water heater, and the temperature of the water as it enters the boilers is about 200 deg. Fahr. The two blower sets were built by the American Blower Company.

The two large pumps in the power-house engine room are driven by De Laval steam turbines. The centrifugal pumps are directly connected by means of the reduction gearing, and run at 875 r.p.m. with a rated output of 9000 gal. per minute with a 56-ft. head. These pumps discharge into a concrete pressure pipe 530 ft. long and 39 in. in diameter, which empties into the E line canal. The circulating pump that is used for irrigation purposes is also driven by a De Laval steam turbine. The pump runs at 2500 r.p.m. with a rated output of 900 gal. per minute against a 45-ft. head. This pump discharges into a concrete pressure pipe 224 ft. long and 30 in. in diameter, which empties into the D line canal. A Wheeler surface condenser is used in connection

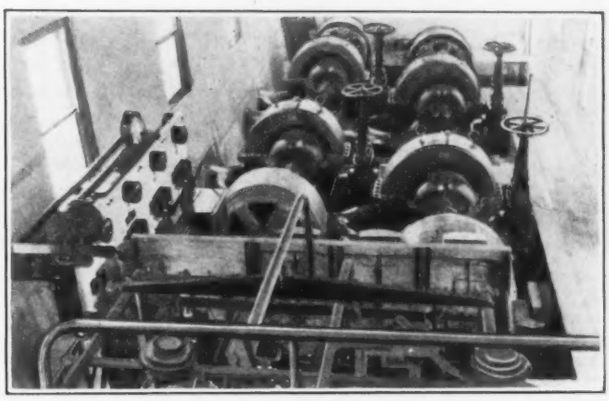


Fig. 2—Interior of Pumping Station at Buford, N. D.

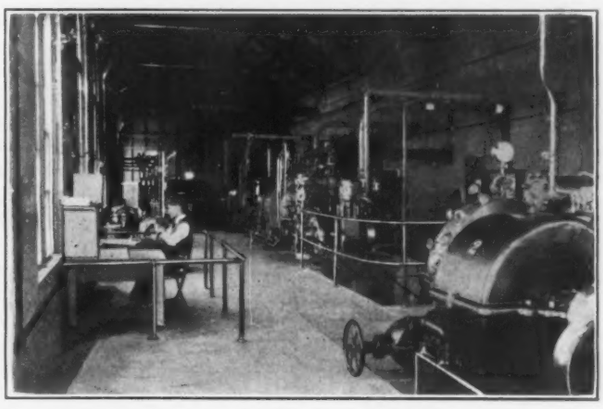


Fig. 3—Engine Room at Williston, N. D.

with these turbines. Vacuum is maintained by means of a 5-in. by 12-in. by 10-in. Edwards air pump.

The main generating equipment consists of two 300-kw General Electric units and one 500-kw Allis-Chalmers unit. They supply three-phase energy at 60 cycles per second and 2200 volts. The General Electric generators are driven at 1800 r.p.m. by four-stage Curtis steam turbines. A Worthington surface condenser containing 2540 sq. ft. of cooling surface is used in connection with these turbines. When the small De Laval pumping unit is not in operation circulating water is supplied by a 10-in. Worthington centrifugal pump. This pump is driven at 600 r.p.m. by a 40-hp General Electric induction motor and receives energy at 220 volts. This condenser is provided with a 6-in. by 12-in. by 12-in. Worthington dry-air pump and also with a Worthington centrifugal pump for removing the condensed steam. The 5-hp General Electric motor for the centrifugal pump runs at 1800 r.p.m. and receives energy at 220 volts.

The Allis-Chalmers Bullock type generator is driven at 3600 r.p.m. by a four-stage Allis-Chalmers steam turbine. A Le Blanc jet condenser is used in connection with this turbine. The circulating water and vacuum are supplied by two centrifugal pumps mounted on the same shaft and driven by a 60-hp Westinghouse steam turbine.

Excitation for the generators is furnished by three units, the largest of which is a 50-kw double generator set built by the Three Rivers Electric Company. The direct-current

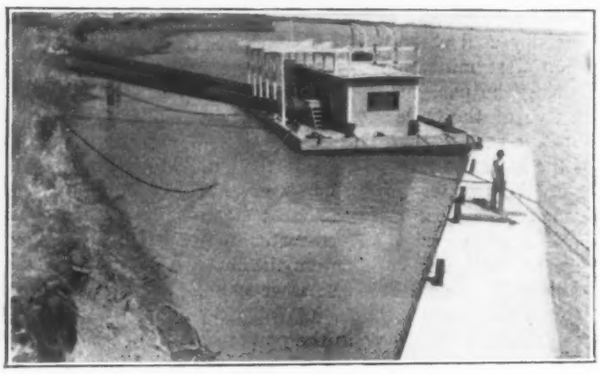


Fig. 4—Barge at Buford, N. D.

and alternating-current generators are mounted on the same shaft and are driven by a 10-in. by 10-in. directly connected Lycoming engine. The alternating-current generator furnishes energy at 220 volts and is used to run the coal crusher and conveyors at times when the larger generators are not in operation. The direct-current generator furnishes energy at 125 volts. The second exciter in size is a 17.5-kw General Electric motor-generator set that runs at 1200 r.p.m. and furnishes energy at 125 volts. The third exciter is a 15-kw General Electric marine set that is run at 400 r.p.m. by a directly connected 6-in. by 8-in. Marine engine. The generator furnishes energy at 125 volts and is usually run when energy is needed only for the station lighting.

Use is made of a ten-panel switchboard built by the General Electric Company. There are two sets of 150-kw transformers at the power house that may be used singly or together to step up the voltage for the Buford transmission line. Aside from these there are two station transformers with 220-volt secondaries that are used in connection with the auxiliary motors.

Pumping Station No. 2 contains two pumping units. The larger one is driven by a 100-hp Westinghouse induction motor. The 20-in. volute pump has an output rating of 9000 gal. per minute with a total lift of 30 ft. The smaller unit is driven by a 75-hp Westinghouse induction motor. The 18-in. volute pump directly connected to this motor has a rated output of 6700 gal. per minute with a total lift of 30 ft. The pumps discharge into a concrete pressure pipe 168 ft. long and 39 in. in diameter from which the water flows up the valley toward Station No. 4.

Pumping Station No. 4 contains only one pumping unit, and it is of the same size as the larger unit of Station No. 2. The pump discharges into a concrete pressure pipe 1043 ft. long and 30 in. in diameter, which empties into the canal. The total lift for this station is 33.5 ft. Energy is transmitted to Stations No. 2 and No. 4 at the busbar emf of 2200 volts, and oil-cooled transformers are installed at each station to reduce the emf to 220 volts, at which the motors are run.

The Williston barge is 72 ft. by 25 ft. and draws about 30 in. of water. It contains four 135-hp General Electric induction motors, which drive 24-in. volute directly connected pumps. The rated output of each pump is 13,500 gal. per minute, with a total lift of 28 ft. The pumps discharge into steel pressure pipes 110 ft. long and 24 in. in diameter, which deliver water to the settling basin. Each of the pipes has two flexible joints to allow for variations in the position of the barge.

The 22,000-volt transmission line from the Williston power house to the Buford station is 26.6 miles long. Each of the three copper wires consists of three strands 118 mils in diameter. The wires are placed 3 ft. apart, and the distance between the wooden transmission poles of the system is about 200 ft.

The pumping station at Buford contains four pumping units. Two of the 160-hp General Electric motors are of the synchronous type and two are of the induction type. The motors are directly connected to 20-in. volute pumps of 7200 gal. per minute rating, with a total head of 50 ft. The pumps discharge into a concrete pressure pipe, 2780 ft. long and 48 in. in diameter, which empties into the main canal. A small motor-generator set furnishes direct current at 115 volts for the field circuits of the synchronous motors.

There is one set of 300-kw Westinghouse transformers in the Buford station that step down the transmission line voltage to 2000 volts, at which the motors at both stations are run. A 15-kw General Electric station transformer again steps down the voltage to 220 volts for the motor-generator set and the lamps. Aside from these there are two high-tension shunt and two high-tension series instrument transformers that were built by the General Electric Company. The ratio of these transformers is 22,000 to 110 and 8 to 1 respectively.

The Buford pumping barge is 60 ft. by 25 ft., and it draws about 30 in. of water. It contains two 150-hp Westinghouse induction motors that drive 24-in. volute pumps at 435 r.p.m. The rated output of each pump is 13,400 gal. per minute, with a total head of 30 ft. The pumps discharge into steel pressure pipes, 230 ft. long and 24 in. in diameter,

ACRE-FEET OF WATER PUMPED IN JULY, 1911.

	Acre-Feet.	Lift in Feet.	Acre-Feet Raised 1 Ft.
Station No. 1 (power house), Williston	129.85	28.00	3,640
	1,086.73	56.00	60,860
Station No. 2, Williston	1,009.46	28.39	28,660
Station No. 3 (barge), Williston	2,488.30	23.70	58,970
Station No. 4, Williston	619.69	33.52	20,770
Station No. 1 (barge), Buford	982.28	24.00	23,570
Station No. 2, Buford	982.28	47.00	46,170
	7,298.59		242,640

which empty into the settling basin. The centrifugal pumps at the stations of the two projects were built by the Jeanesville Iron Works Company.

The total output at the Williston power house for July, 1911, was 511,375 kw-hr., with a load-factor of 78.5 per cent. The total lignite consumed was 2550.25 tons at a cost of $1.23 per ton. The average was 9.97 lb. of coal fired per

kw-hr., or 5.98 lb. of dry coal per kw-hr., assuming that the coal contains 40 per cent moisture.

The acre-feet of water pumped during the month of July, 1911, is shown in the accompanying table.

The operating season for the two projects is now from about June 1 to Sept. 1, and the farmers are required to take water in rotation in order to decrease the operating expenses. It would perhaps be more desirable to have the operating season extend over a longer period of time, with little or no pumping in August, when the farmers are getting their crops off the land, but this is impossible because of the high fixed charges that would be present during the idle period. The building cost is about $38 per acre, payable in ten annual instalments. Water now costs the farmer $1 per acre-foot, and the operating charges are $1.50 per acre per year.

The projects have been very successful in their operation under the management of the United States Reclamation Service. Excellent crops have been raised from the naturally fertile soil by the use of irrigation, while dry-land farming has been practically a failure for the past two years because of droughts.

INSTRUMENT CALIBRATION BY MEANS OF THE SPARK-GAP.

By Ralph P. Clarkson.

In the *Electrical World* of May 18, 1911, the writer described and showed photographs of the ordinary form of spark-gap apparatus used for measuring very high potentials. The method there described briefly and which was recommended by the Standardization Rules of the American Institute of Electrical Engineers approved June 21, 1907, is that usually followed in measuring the test voltage when determining dielectric strength by the use of the spark-gap. The gap is first carefully adjusted and then the voltage is raised until the break-down of the dielectric occurs and the passage of the spark across the gap, whereupon the voltmeter is read and the voltage recorded. Of course the voltage required depends on the maximum value of the voltage wave, and the form of the wave is of no importance so far as the actual disruptive voltage is concerned, although of great value in determining the effective voltage corresponding to the maximum and in other calculations.

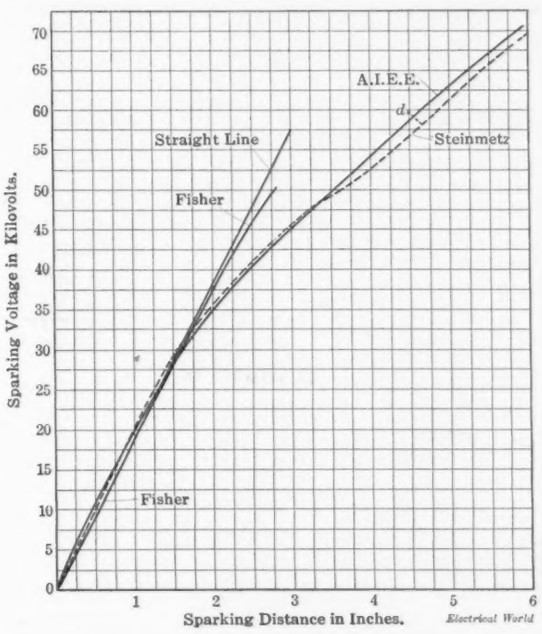


Fig. 1—Relations Between Sparking Distance and Voltage.

There is a problem, however, in calibrating instruments by means of the spark-gap in air which is not met with in dielectrics in that the dielectric is not a moving body, while with meters, for example, there is a moving part the position of which must be determined at the exact time that the spark occurs. This is rendered the more difficult by reason of the fact that the voltage drops when the spark passes if there is a circuit-breaker in the primary to prevent a continuance of a power arc, and in any case the passage of the spark causes great fluctuations of the instrument needle.

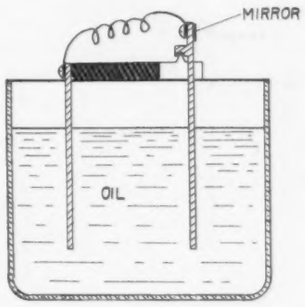


Fig. 2—Repulsion Voltmeter.

For the purpose of calibrating voltmeters and other instruments for use in very high-potential work by comparing them with the spark-gap as a standard, the writer has devised a comparatively simple form of apparatus which appears to have some points of novelty and advantage over those known to him at the present time.

In Fig. 1 are shown the curves giving the relation between sparking distance and sparking voltage (effective), using sharp points. The authorities are marked on the curves. The curve of Fisher and that recommended by the A. I. E. E. cross at 25 kilovolts, and it will be noted that below that point Fisher's voltage is lower and above that point Fisher's voltage is higher. The dotted line shows the result of Steinmetz's investigation in 1898 upon which the A. I. E. E. curve is based, the point *d* being a point of the curve. The dash line is a straight line passing through the intersection of the curves of Fisher and the A. I. E. E. and through the origin. It is evident that Fisher's curve hugs the straight line very closely.

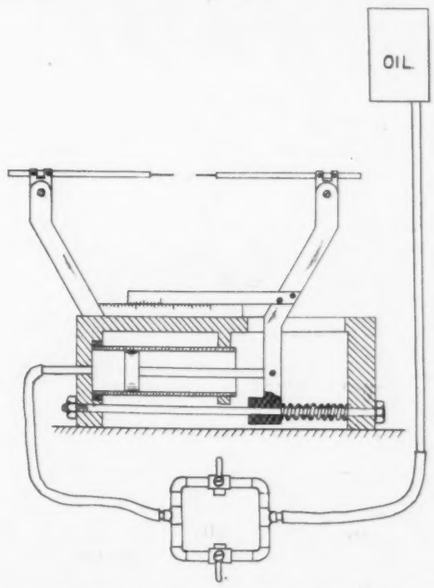


Fig. 3—Apparatus for Instrument Calibration.

A careful study of these curves shows that for high potentials the curve is in each case a straight line, which means that a change in gap length gives a proportional change in the voltage required to jump the gap. For example, with a 1-in. gap an increase of ¼ in. in the gap means an increase in voltage from 20 kilovolts to 24¼ kilovolts; that is, an increase of 25 per cent in gap means an increase of about 21 per cent in the voltage required to jump the gap, while an increase in gap from 3 in. to 3½ in. (16 2/3 per cent) means an increase in voltage from 45¼ kilovolts to 49¾ kilovolts (10 per cent). Whatever error is made then in the gap will create a less error, proportionally, in the voltage.

However, the gap is something that can be measured with the highest degree of accuracy, while it is as yet very difficult to read any instrument for measuring high tension within a considerable percentage owing in part to the necessity for providing a long range and a limited scale. It is, of course, much easier to read the instrument and the accuracy of the reading is much greater with the voltage steady and the pointer at rest, when several readings may be taken, than it is with a constantly changing voltage, at the exact position which the pointer reaches when the spark jumps across the gap, especially if the voltage changes. Under the usual circumstances but one reading can be taken, and that during a very small interval of time and at an unexpected moment.

With a repulsion voltmeter such as is shown in Fig. 2, similar to the one used in the electrical tests described in the article above mentioned, where a photograph and a description of the voltmeter are given, the deflection on the scale during part of the calibration was from 9.55 to 25.20, while the voltage range for that part of the scale was from 5 to 71 kilovolts. It is apparent, therefore, that an error of 0.05 of a division of the scale (which was as close as the voltmeter could be read under the most favorable circumstances) would mean an error of about 211 volts, the exact amount depending on the part of the calibration curve where the reading was taken. It would be, indeed, very difficult to make as close a reading as this each time, on account of the unexpected jump of the spark, especially as the observer is regulating the resistance and cannot watch for the spark. With the minimum of 5000 volts this error is about ± 4.22 per cent, which is quite large. It is, of course, extremely desirable that every reading be as correct as it is possible to get it, as only by reducing so far as we can those errors we recognize, however small, is it possible to arrive finally at right results.

With the apparatus shown in Figs. 3, 4 and 5 more accurate readings can be obtained than are possible with the old method, as will be seen presently. In using this device the voltage is held constant and the spark-gap varied. The spark-gap length may be read by means of the vernier to one one-hundredth of a millimeter, while, owing to the construction of the device, as many readings as desired may be taken. Then, by reading the voltmeter with the voltage steady at one point where it is set, the readings will be much more accurate and they may be taken as many times as desired, each time without the disadvantage of a continually moving pointer and a disconcerting drop at the critical moment. Then again, with this apparatus it is possible to watch the spark carefully and thus to some extent determine the condition of the needle points, especially if no careful preliminary examination of them has been made. This is more important than it would seem at first thought. In his paper on "Spark Distances Corresponding to Different Voltages," before the International Electrical Congress, Mr. H. W. Fisher pointed out that the commercial needles contained in a package varied among themselves in sharpness to such an extent as very seriously to affect the sparking distances even up to 20 per cent error with a disruptive voltage of 6 kilovolts, and at 45 kilovolts the error due to the needles not being absolutely sharp might be as much as 14 per cent. It will be noted that Mr. Fisher's curve, given in Fig. 1, more nearly approaches the straight-line relation than the curve adopted by the A. I. E. E., which difference, in the upper part of the curve at least, might be almost wholly due to the difference in sharpness of the needle points of the two experimenters. It may be that if we could obtain points sharp even under a magnification of 1000 or 1500 diameters an approach still nearer to the straight-line relation might be obtained. Because of this it is very important that the spark be watched so that any abnormal condition may be observed.

In order to provide for several readings of the instrument to be calibrated, for several readings of the spark-gap distance, for an observation of the spark itself, and therefore for more accuracy in the calibration, the apparatus illustrated in Fig. 3 was designed. This apparatus consists of a glass cylinder in which is a movable spring-pressed piston to which one of the sparking point holders is attached, the other sparking point holder being stationary. The construction of the holder for the sparking points is shown in Fig. 4, there being a spring member which holds the needle forcibly against the side of the rod but allows it to be very easily removed and a new one inserted by simply compressing the spring end at *a*. Mercury is used in the construction of the holder for the purpose of securing good contact.

The apparatus is operated by oil contained in the elevated tank shown. Leading from the tank is the rubber tubing connecting the valves, cylinder and tank together. These connections are flexible so that the operating valves may be used where desired. The lower valve is a large one and is used for coarse adjustment, while the upper one is a very small valve and is used for fine adjustment. Each valve has an opening into the air and a portable catch basin is used to collect the oil flowing from these openings and to return it to the elevated storage tank. As shown, a vernier is used to give the spark-gap distance.

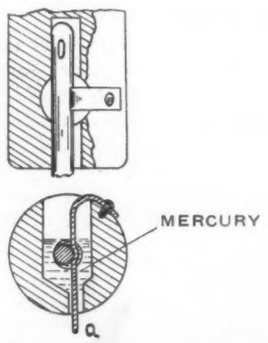


Fig. 4—Construction Details of Sparking-Point Holder.

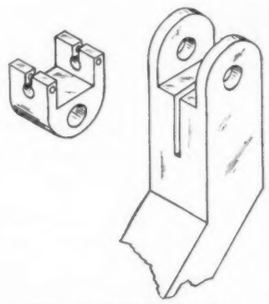


Fig. 5—Details of Rod Mounting.

In accordance with the A. I. E. E. Standardization Rules the rods on the ends of which the spark points are placed are of a length at least twice that of the longest gap to be used, and no other part of the apparatus is placed near the gap within a radius of twice the length of the gap. Fig. 5 shows details of the mounting of these rods. It is of the greatest importance that the rods shall not sag but that the sparking needles be in line with their points exactly opposite each other, and so an adjustable device is necessary as shown.

The zero reading of the vernier having been determined with the sparking points just touching or with a block of known thickness between them and the points separated a distance greater than the sparking distance of the voltage for which the instrument is to be calibrated, the voltage is adjusted and fixed by means of whatever form of variable resistance is used, to give a certain desired reading of the instrument to be calibrated, and this reading of the instrument is made as accurately as possible and as many times

as desirable, the pointer being quite at rest at times. Obviously the readings may best be taken on the even divisions of the scale, which desirable feature is not possible when the gap is adjusted and the voltage raised until it is sufficient to jump the gap. The points are now brought together by opening the large cock until there is a slight brush discharge, whereupon the large valve is closed and the small valve carefully opened and used for the final fine adjustment. This is accomplished very slowly and the movement of the point is stopped immediately upon the passage of the spark.

The transformer is now disconnected from the source of energy used, and the reading of the vernier of the spark-gap apparatus is taken as often as desired and with a high degree of accuracy by any desired magnifying means. The spark-gap distance having thus been determined, the points are removed and new ones are inserted, carefully aligned and brought together to obtain a new zero reading for the new test. The points are then widely separated, the voltage is again adjusted to give another certain reading, the instrument to be calibrated is again carefully read and the points are brought up to the sparking distance as before.

The controlling valves are opened to the air to allow the points to come together, the oil running out of the cylinder and allowing the spring to operate the piston. To separate the points the oil is admitted to the cylinder from the elevated tank, thus compressing the spring. In place of the oil, of course, any other insulating liquid may be used, if desired, or compressed air may be substituted, in which case the tank need not be elevated.

THE TESTING OF LARGE WATT-HOUR METERS ON FLUCTUATING LOADS.

BY F. A. LAWS AND C. H. INGALLS.

ALL persons responsible for the upkeep of large direct-current wattmeters which are used on a rapidly fluctuating load, such as that of a street-railway system, have experienced difficulties in the testing and adjustment of such meters. Owing to the large number of readings of the current which it is necessary to take in order to obtain a good average the ordinary method of using a stop-watch and of measuring the line voltage and current is a time-consuming operation, and in some cases the fluctuations are so rapid that the use of the ammeter is quite out of the question. An alternative procedure is to take the meter out of service and to send through its coils the current from a storage battery. This current may be controlled by resistors, so that tests at light load and up to 400 amp may be made without the apparatus being too unwieldy to be managed by two persons. For the purpose a couple of Edison cells are convenient, being readily portable. It is, however, desirable to avoid taking the meter out of service, for the test may occupy an hour or more, and the loss of revenue is worth obviating; it may be as much as $5 to $10 for each hour the meter is out of service. Also it is desirable to make the test with the customer's regular load.

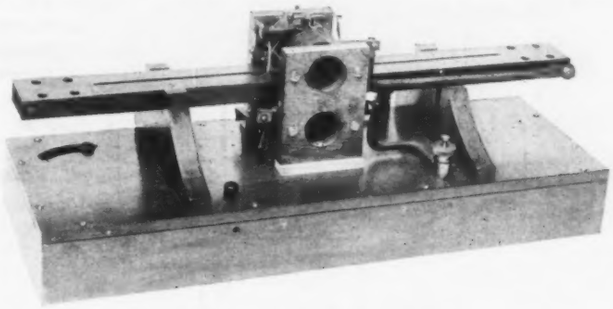


Fig. 2—Differential Multiplier.

These considerations have led us to devise other methods of attacking the problem.

The very convenient forms of test meters developed for alternating-current work naturally suggested similar devices for use on direct-current circuits. Their development, however, is attended with much difficulty. Nevertheless the problem has been solved quite successfully, and the best of these instruments when carefully used are of great service where the conditions of load are extremely variable. Such test meters are made up to a capacity of 150 amp. But for our purposes we desire meters which will take currents from 500 amp up to the largest magnitudes met with in practice. The direct application of shunts to a test meter of the ordinary commutator form is not admissible. Since we desired to retain this type of meter, the following methods of dealing with the problem were devised; they may be regarded as arrangements by which shunts may be so applied to the test meter that errors due to contact resistances and heating are obviated.

The first method is shown in Fig. 1, where for the sake of simplicity the potential connections to the meters are omitted. The arrangement may be called a differential multiplier, for by it the range of the test meter is extended, in this case approximately thirty-fold.

The station busbar is arranged so that it has a narrow gap at *G*. This gap is ordinarily closed by plates firmly bolted in position. The gap should be narrow and the leads so arranged that the field at the meter is not disarranged when the gap is opened. The entire current flows to *a*, where it divides, a comparatively small portion flowing through the fine wire coils of the multiplier *MM'*, the test meter and the adjustable resistor *r* to *b*. The main portion flows through the "coarse coil" *C* of the multiplier, which is in this case a straight bar, then through the resistor *R*, which is of such a magnitude as to give the voltage drop required in the test-meter circuit. The fields due to the currents in *MM'* and *C* are opposed, and in them is placed an astatic movable coil system which is provided with pivots

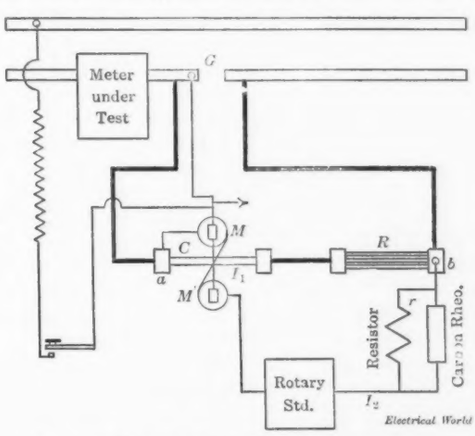


Fig. 1—Differential Multiplier Arrangement.

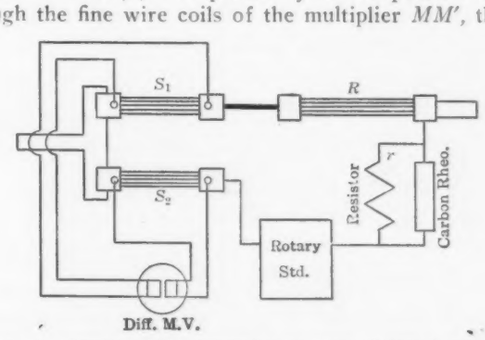


Fig. 3—Arrangement According to Two-Resistor Method.

and a damping device. The movable member, in series with a suitable resistor, is placed across the line and serves to show when the fields due to C and MM' are balanced. In the present instrument 30.7 amp in C is required to

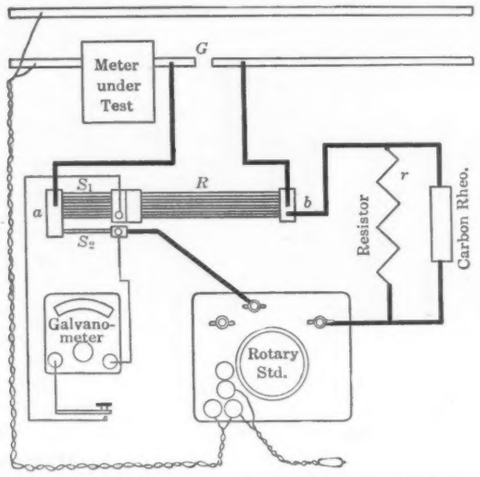


Fig. 4—Simplification of Two-Resistor Method.

balance 1 amp in MM'. The multiplier is brought to a balance by varying r. When this has been done the corrected watt-hours by the test meter are obtained by multiplying its indications by 31.7. The multiplier itself is shown in Fig. 2.

The test meter is of course set up where it will be as free from stray field effects as possible. The leads to it are flexible and readings are taken with the meter in four dif-

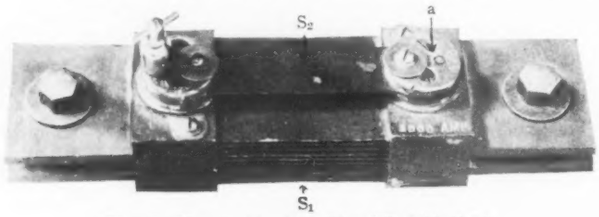


Fig. 5—Shunts Used in Simplified Method.

ferent azimuths 90 deg. apart. For our work this has sufficed; but conditions may be easily imagined where, owing to the change in the distribution of current between feeders which are at different distances from the test meter, this procedure would not give the desired result. In such cases a shielded instrument would be desirable. The multiplier being astatic, with the centers of the upper and lower coils

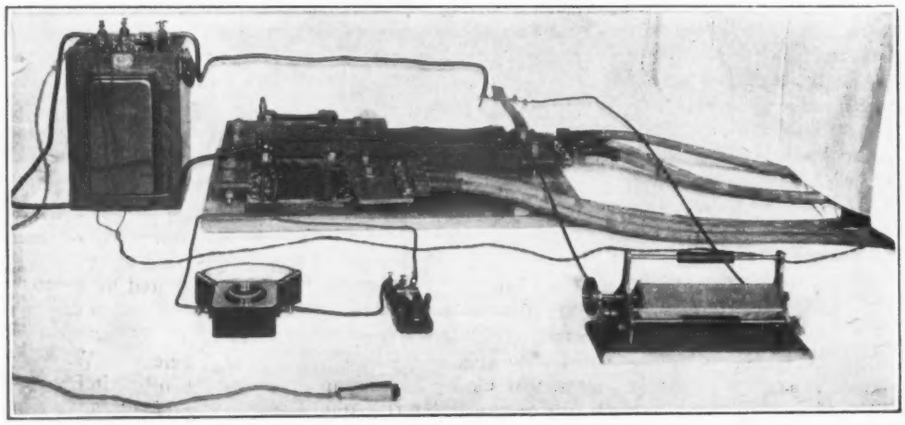


Fig. 6—General Arrangement of Simplified Method.

2½ in. apart, it is not affected by uniform stray fields. Anything that produces a non-uniform stray field—for instance a busbar close to the instrument—might, however, lead to a misjudgment of the balance. So the apparatus should be set up at a fair distance from the switchboard.

Appreciation of this possible difficulty led to the second method, which employs two appropriate resistors, one in the circuit of the test meter and the other in the parallel circuit, the potential drops in the two being made equal by the adjustable resistor r and this equality indicated by a differential millivoltmeter of the D'Arsonval pattern. This arrangement is indicated in Fig. 3. Any shunts which are suited to the purpose may be temporarily bolted together and used for S_1 and S_2. They should, of course, be free from thermal emf errors. We have found this matter troublesome in some cases.

This arrangement may be simplified and the differential millivoltmeter replaced by a pivoted D'Arsonval galvanometer if a special shunt be constructed for the purpose. The last plan is indicated in Fig. 4. The sections of the shunt (see Fig. 5) S_1 and S_2 have a common terminal at a. If the galvanometer stands at zero then $\frac{I_1}{I_2} = \frac{S_2}{S_1}$ and the corrected reading of the test meter is its indication multiplied by $\frac{I_1 + I_2}{I_2}$. By the use of two potentiometers to measure I_1 and I_2 when the galvanometer is balanced this factor can be very accurately determined once for all. This is the final form of the apparatus and one which has been used very successfully for over a year. The entire arrangement connected for 2000 amp is shown in Fig. 6.

The capacity of the test meter is 40 amp. Two sets of shunts and auxiliary resistances R are mounted on the same base; the ratings are 1000 amp and 2000 amp. The voltage drop in the shunts at full load is 100 millivolts and in the resistor R it is 400 millivolts. The adjustable resistor r is a strip of Baker metal, the effective length of which can be altered by the use of screw clamps. Placed in parallel with the strip is a carbon compression rheostat by which the fine adjustment is affected.

The entire apparatus, including the necessary cables but not the test meter, may be stowed away in a chest 31½ in. x 19 in. x 14 in. which can be conveniently shipped from station to station.

IMPROPER WATTHOUR-METER CONNECTIONS.

By C. A. Howell.

The manufacturers have arranged most watthour meters so that, when used without shunt or series instrument transformers, it is impossible to connect them up to measure more than the true energy delivered. While this is very fortunate for the reputation of the meter, when the class of men usually found on such work is considered, the general fact has become so well known that most electrical men believe it is true for all meters. Such is, however, by no means the case, as the following shows:

Where a meter is used with instrument transformers its secondary leads are frequently run in conduit or are otherwise concealed so that inspection of the connections is difficult. The meter is then connected by the cut-and-try method, on the assumption that it cannot be connected to read too much, provided the power factor is above 50 per cent, so that it is left reading the maximum possible. Such a method is, in fact, very unreliable and should never be

used, the leads being instead carefully traced or rung out and dependence for the proper connection placed on actually seeing that each lead is connected to the correct terminal.

Fig. 1 shows a primary meter with all eight leads brought

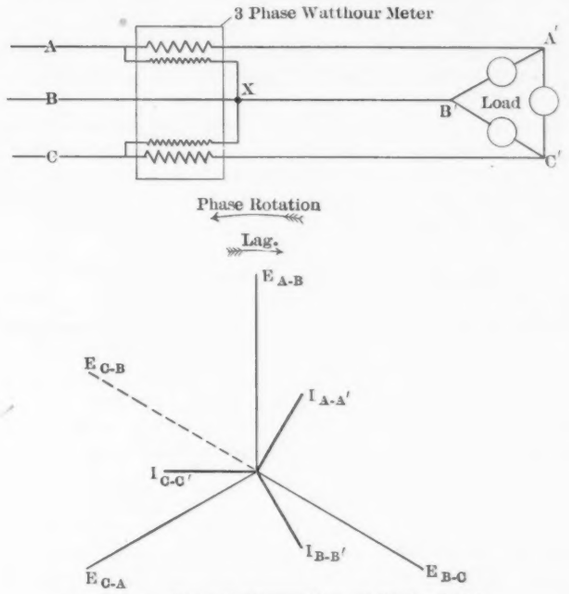


Fig. 1—Correct Connection of Meter Coils.

out, the transformers being omitted for the sake of simplicity.

The upper element of the meter then reads:

$$I_{a\text{-}a'} \times E_{a\text{-}b} \times \cos\ (\Theta + 30 \text{ deg.})$$

and the lower element reads:

$$I_{c\text{-}c'} \times E_{c\text{-}b} \times \cos\ (\Theta - 30 \text{ deg.})$$

where Θ equals the angle of lag due to the power factor, Θ being zero in the diagram shown, which is for unity power-factor. Now, as the power-factor falls off, the current $I_{a\text{-}a'}$ lags back (in the direction shown by the arrow for lag), increasing the angle between it and its pressure $E_{a\text{-}b}$,

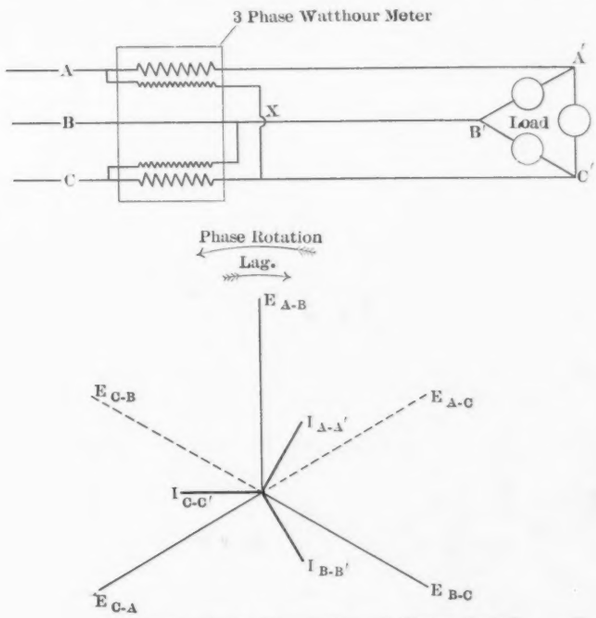


Fig. 2—Incorrect Connection of Meter Coils.

so that the upper element will run slower and slower until, for a 60-deg. lag corresponding to 50 per cent power-factor, it stands still, and for a farther lag it tends to reverse and run in the opposite direction.

On the contrary, the current $I_{c\text{-}c'}$ moves toward its pressure $E_{c\text{-}b}$, the elements speeding up until it is in phase for a power-factor of 86.6 per cent. Then, as the lag increases, the current moves on clockwise, past its pressure, and the element slows down, until at zero power-factor the upper element in tending to run backward just equalizes the torque of the lower element, and the meter stands still.

Fig. 2 shows the same meter with a very slight change in connections, namely, the pressure wire X taken off of the B phase and connected to the C phase.

The corresponding vector diagram shows that the upper element now reads:

$$I_{a\text{-}a'} \times E_{a\text{-}c} \times \cos\ (\Theta - 30 \text{ deg.})$$

and the lower element reads:

$$I_{c\text{-}c'} \times E_{c\text{-}b} \times \cos\ (\Theta - 30 \text{ deg.})$$

this diagram also representing unity power-factor, and Θ equal to zero.

At this unity power-factor the meter will read correctly, but as the power-factor falls off and the current lags in the direction shown, both currents approach their respective pressures and thus the meter speeds up when it should slow down, both elements reading the same for all power-factors. At zero power-factor the meter will be infinitely fast, as there will be considerable registration with no true energy delivered.

The accompanying table shows the effect of this connection on the meter.

EFFECT OF IMPROPER CONNECTION ON METER.

True Power-Factor.	Apparent Power-Factor.	UPPER ELEMENT. Reads.	UPPER ELEMENT. Should Read.	LOWER ELEMENT. Reads.	LOWER ELEMENT. Should Read.	Per Cent Meter Error.
1.000	1.000	0.866 I E	0.866 I E	0.866 I E	0.866 I E	00.0
0.940	1.138	0.985 I E	0.643 I E	0.985 I E	0.985 I E	21.0 fast
0.866	1.153	I E	0.500 I E	I E	I E	33.3 fast
0.500	1.000	0.866 I E	Zero	0.866 I E	0.866 I E	100.0 fast
0.300	0.851	0.737 I E+	0.217 I E−	0.737 I E	0.737 I E	2734.6 fast
0	0.578	0.500 I E+	0.500 I E−	0.500 I E	0.500 I E	Infinite

There are a number of other very interesting possible connections, as, for instance, where the upper pressure coil is connected to work with the lower series coil and the lower pressure coil with the upper series coil, the latter pressure being reversed. In this case the meter will be very fast on low power-factor, but will stop on unity power-factor.

CONTROL OF WATERWHEEL GENERATORS.

The Billings & Eastern Montana Power Company, at Billings, Mont., ordinarily sends several hundred kilowatts into the 50,000-volt transmission line connecting it with the Butte Electric Company's system. An interruption to this line would suddenly remove a large part of the load from the Billings plant, causing the waterwheels to race before the governors could act and resulting in a rise in pressure on the local system. This is prevented by arranging an adjustable water rheostat load to be added to the bus in case the line switch opens. The latter oil switch is provided with both overload and no-voltage release. When it operates it closes a 200-amp outdoor-type oil switch, connecting in the water rheostat. The setting of the latter has meanwhile been adjusted so that the load that will be taken by it nearly equals that being sent out on the line. After the rheostat has thus taken over the surplus load its plates can be raised slowly from the water, giving the governors time to act and decrease the water going through the wheels.

Central Station

Management, Policies and Commercial Methods

ESTABLISHING A NEW BUSINESS CENTER.

Two large mercantile firms of Salt Lake City, Utah, the Auerbach and Keith-Obrien companies, have established a new retail business center at the corner of Third Street South and State Street, with the aid of a magnetite-arc "white way" lighting system which extends from State Street east on Third Street South. These 4-amp arc lamps are hung on scroll necks from the trolley posts, fourteen to each 600-ft. block, or seven on each curb. Two and one-half blocks of this lighting are now installed, the Utah Light & Railway Company, which supplies the service, receiving $5 per month per lamp from the abutting property owners. The initial installation was promoted by the merchants at the end of the street, who realized the tremendous pulling power of effective lighting in drawing people to their windows in the new section. It is now proposed to extend this lighting in Salt Lake on State and Main Streets six blocks south to Ninth South and west on West Third Street South to the Rio Grande depot.

HANDLING COMPLAINTS.

At a recent meeting of The Milwaukee Electric Railway & Light Company Section of the National Electric Light Association a paper was read by Mr. James Mulder on "Complaints." The speaker emphasized the point that the company wants the confidence of its customers as well as their money for its service. In relation to meter readings he said that there might be some improvement on the part of the central-station people in the accuracy of reading meters. There is a certain proportion of misreadings. Complaints due to inaccurate readings are, of course, justified, and these complaints constitute a considerable proportion of the whole number. Decreasing the percentage of misreadings of meters increases the efficiency of the service. A pigeon-holed complaint is not an asset, and there should be quick action on all complaints. Another point to which some attention may be given, perhaps, is careful inspection of bills before delivery to customers. If there is any wide discrepancy between the bill and the usual rate of consumption, it is well to look into the matter before the bill is sent out, to prevent misunderstanding.

INTENSIVE MOTOR-SERVICE CULTIVATION.

The Kansas City Electric Light Company's sales department has just completed a novel and successful campaign for new business. Early in January it was decided to send to the National Electric Light Association convention in Seattle that salesman who should score the greatest total of points as authorized in a schedule adopted. These schedules were so arranged that every man had a chance to win at least some points each month. In this way the light men were encouraged and the total of small contracts shows the results. Each month comprised a separate competitive period, and the points secured by each man were carried forward to be added to subsequent winnings. In four months 345 motor-service contracts were secured, totaling 8321 hp, these contracts being divided as follows: 10 hp and under, 281; 11 hp to 50 hp, 44; 51 hp to 100 hp, 10; 101 hp to 200 hp, 4; 201 hp and over, 6.

The winner of the prize secured thirty-eight contracts totaling 2332 hp. The competition was keen up to May 1, and one of the gratifying results was the development of the "closing" ability in the different engineers. The company is so well pleased with the results obtained that it has added an additional engineer to the department and also furnished an automobile for the exclusive use of the salesmen.

ELECTRICITY IN A BRICK PLANT.

In brick-making plants proposals for central-station motor drive are often met with the objection that steam is required anyway to dry the molds, so that an isolated plant is best suited for motor service. An electrically heated molding machine having a capacity of 22,000 bricks a day is now in use at Pueblo, Col., the heating element being improvised from the parts of eight 500-watt flatirons by Mr. E. F. Stone, superintendent of lighting and motor service. This drying heater thus consumes 4 kw and is operated about ten hours daily, under the regular motor-service rate of the Pueblo company, which supplies energy for 60 hp in motors in the same brick plant. In fact, this provision of an electrically heated mold proved the turning point which secured the brick manufacturer's contract, for the reason that if steam was to be kept up for drying the molds, he might as well continue running his isolated plant. At the present time the cost of his electric service nearly equals the fuel and supply expenses of the former isolated plant, but the wages of an engineer and fireman are saved. Incidentally, with motor drive the operation of the machines is speeded up by 5 or 6 per cent and the output increased accordingly. The molds were electrified at the central-station company's shops, without interruption to the brick plant's operation, since duplicate molds were provided. In case of injury to any of the 500-watt heating elements, new parts can be substituted without necessity for dismantling the machine.

3000 CUSTOMERS IN TOWN OF 10,000.

Pocatello, Idaho, with a population of 10,000, has 3000 electric customers connected to the lines of the Idaho Consolidated Power Company, or one customer for approximately every three inhabitants. Except for 600 commercial-class meters, the remainder are residence users, who pay 10 cents per kw-hr. and $1 monthly minimum. By actual count 95 per cent of the houses in Pocatello are wired, no gas service having been available in the town until recently. The community supports four electrical supply houses, whose efforts are joined with those of the central station in keeping the city well supplied electrically. A large number of electric irons are in use, and cooking with electricity is being encouraged by a special rate of 2.5 cents per kw-hr. without load-factor limitations.

To facilitate the reading of residence meters nearly all these instruments are installed on the wall outside the house, at the point of entry of the service wires. Where the eaves do not offer sufficient protection from direct access of the weather, a little wooden "doghouse," with peaked roof, vertical sides and open front and bottom, is used to inclose the meter. The latter is fixed at a height of about 8 ft. above the ground, so that the dials can be seen by the reader without difficulty. This outside installation of customers' meters avoids temptation to im-

proper connections and theft of energy, besides saving time in the reading of the dials. Five men read the 3000 meters in Pocatello in two days. Mr. M. E. Hughes, manager of the company, reports no troubles due to outside settings of the meters.

ELIMINATING ISOLATED-PLANT COMPETITION IN BROOKLYN.

A long-term contract recently entered into by the Edison Electric Illuminating Company of Brooklyn and the owners of one of the large clothing stores in its territory is of more than usual interest, as it provides for the replacement by central-station service of the only block system in the borough of Brooklyn.

This system had been in use for approximately six months and was the outcome of a small plant that had been operated by the clothing firm. At the instance of an engineering supervision concern about $10,000 was spent in enlarging the plant, and business was solicited from all of the customers of the Edison company on the block.

Located in one of the most active parts of the downtown district—Flatbush Avenue and Fulton Street—these customers require a class of service highly conducive to the successful operation of a block system. All of the stores are long-hour users of energy for lighting, and there are two restaurants which require large amounts of steam and motor service for refrigeration purposes in addition to their desirable lighting load.

As the promoters of the block plant offered to supply energy for lighting and motor service at rates 15 per cent less than those of the Edison company and guaranteed to show a saving of approximately 10 per cent in steam-heating cost, all but two of the business interests on the block discarded the service of the central-station company and abandoned their individual heating equipment.

Six months after the block plant was placed in operation the motor-service engineer of the Edison company convinced the owners of the plant and those served by it that the central-station company could furnish an equal amount of energy to them at lower cost, in spite of the economy insisted upon by the supervision company in the operation of the plant. As a consequence, a five-year contract to supply about 300 kw, the load formerly carried by the block plant, has been secured by the Edison Electric Illuminating Company of Brooklyn and a plant valued at $25,000 is lying idle.

Several other desirable contracts have also been closed by the company in the past few weeks. One of these is with the Eastern District Terminal Company, calling for 400 hp in motors, to operate equipment in freight yards, hay sheds and a sulphur mill. The electrical installation—all details of which were handled by the central-station representatives—will replace 500 hp in steam engines and 20 hp in gas engines. Although the plant was located on the river front, with an abundant supply of water for condensing purposes, and there is a coal yard on the premises, the annual saving with central-station service will be close to $3,000.

One of the largest shipbuilding and repair yards in the country, the Erie Basin Dry Docks, owned and operated by the Robins Dry Dock & Repair Company, occupying a half mile on the Brooklyn waterfront, is the latest addition to the list of large industrial enterprises in Brooklyn now served from the mains of the Edison company. After a long experience in operating a steam plant, after a thorough trial of the Edison service, and after exhaustive analysis of the costs and merits of other methods of obtaining energy, the shipbuilding company had just closed a long-term contract with the Brooklyn company for its power requirements. About 4500 hp will be used for dry-dock pumping, driving air compressors (which furnish air to numerous tools on the docks) and for work done in extensive machine shops, etc.

A contract for 500 hp additional motor service has been closed with the New York Dock Company for use in the premises of one of its tenants, the International Type-setting Company. This addition makes a total connected load of nearly 3000 hp furnished to this customer by the Brooklyn company.

With these additions there is now more than 80,000 hp in motors connected to the mains of the Edison company. As each of these new contracts has been secured in the face of keen competition, the record is a notable instance of the effective work that can be done by an intelligent motor-service department.

TWO-METER OFF-PEAK RATE UNDER RETAIL SCHEDULE AT SALT LAKE CITY.

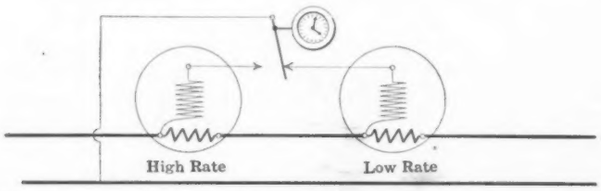
To any customer under its retail schedule who defrays the cost of a time switch and pays the minimum charge for a second meter (making a total minimum of $2 a month), the Utah Light & Railway Company, of Salt Lake City, offers off-peak energy at 5 cents per kw-hr., a reduction of practically one-half its full-rate charge, the schedule of which is: First 250 kw-hr., 10 cents; second 250 kw-hr., 9 cents; third 250 kw-hr., 7 cents; fourth, 6 cents; fifth, 5 cents, and all over 1250 kw-hr., 4 cents. This energy may be used for lighting, vehicle charging, heating and cooking and motors, an extra minimum of 50 cents per hp being added, however, for all motors connected over 4 hp. A discount of 10 per cent is allowed for prompt payment in the case of all the above charges, making the net full rate 9 cents per kw-hr. for the first block of 250 kw-hr. and the off-peak rate 4.5 cents net. The peak hours during which the two-meter customer is charged the full rate are specified for each month in the year, and the time-switch settings are changed accordingly. The limiting hours of this schedule are: March, 6.30 to 10 p. m.; June, 8 to 10 p. m.; September, 6.30 to 10 p. m.; December, 5 to 10 p. m.

During these hours the time-switch opens the shunt circuit of the low-rate meter and closes that of the high-rate meter, transferring the registration of the load from one instrument to the other. The scheme of connections is shown by the accompanying sketch. The two-meter customer who wishes to take advantage of this off-peak rate, as already mentioned, pays $1 monthly minimum for each of the two meters, besides purchasing outright the time switch, which the company does not furnish. The cost of the time switches alone on those installations thus far put in service has averaged $25 per switch, the best grade of Anderson and Campbell clock switches being used. The meter department of the Salt Lake Company is now experimenting with the construction of a less expensive switch which it is hoped can be marketed to the customer for $10 or less, bringing the off-peak schedule more within the grasp of the average user. An inspector mounted on a motor cycle makes weekly rounds of the two-meter installations, overlooking them and setting and winding the clocks. Under his contract the customer, however, agrees, if requested, to keep his clock mechanism wound.

A so-called optional rate is also offered by the Salt Lake company, making use of a demand element and an energy element of charge. Where service is assuredly wholly off-peak, the demand portion of the charge is reduced by one-half, the energy portion remaining the same. The minimum under this schedule is $2 a month for a 1-hp motor and $1 additional for each added hp of motor rating. Thus a customer who uses his 5-hp motor less than the amount of his guarantee is required to pay $6 a month, while by putting in the two-meter rate his minimum would

be $2.50 a month for the same 5-hp unit. A special heating-appliance schedule, retained by the Salt Lake company, is its 6-cent net rate for all energy used at any time of the day over a special heating-appliance circuit, the minimum charge for the separate meter in this case being $2.50 a month.

Plans of meter control for such an off-peak schedule



Single-Throw Clock Switch Used in Connection with Off-Peak Rate Schedule.

suggested by visitors to Salt Lake have included methods of transferring the meter connections wholly under control of the central station, by means of pilot circuits, harmonic devices or resonant frequency schemes. These would relieve the necessity for frequent winding, setting and peak-period changing of the individual clock switches, besides saving the cost of the clocks. Another suggestion has been that with the clock scheme used the low-rate meter shall be connected permanently in circuit, the high-rate meter being cut in only during the peak period. A single-throw clock switch might then be substituted for the double-throw switch now required, simplifying the construction necessary where a less expensive commutator-type clock switch is used. In case of poor contact or failure of the switch to operate, a record of the kilowatt-hours used would then be afforded by the low-rate meter at least, and its readings would offer a desirable check on the high-rate meter figures.

Wiring and Illumination

ULTRA-VIOLET RADIATION FROM ORDINARY ILLUMINANTS.

By M. Luckiesh.

The amount of ultra-violet radiation that is emitted by light sources is of interest because of the possible deleterious physiological effects that may arise therefrom. It is also of secondary interest when choosing illuminants for photographic purposes. The visible spectrum extends into the short-wave region to about 400 μμ, and it is perhaps safe to state that for moderate intensities no harmful physiological effects arise from radiation of longer wave-length than 350 μμ. The extent of the extremely harmful region is a matter which is as yet quite unsettled, although many authorities will perhaps agree that all ultra-violet light of shorter wave-length than 350 μμ is active in the destruction of animal tissue. However, consistent evidence on this point is lacking. Very excessive intensities of visible rays cause painful irritation, and it is claimed by some that snow blindness is due to this cause. There is an abundance of ultra-violet radiation in sunlight, especially at high altitudes, and snow has been found totally to reflect those rays, so that it is quite likely that the ultra-violet rays are largely responsible for snow blindness. Photographic plates ordinarily used are sensitive only to the short-wave visible light and the ultra-violet rays. However, plates can be made sensitive throughout the whole visible spectrum. The plates used in this investigation were ordinary lantern-slide plates sensitive from the blue-green region throughout the ultra-violet spectrum.

The short-wave spectra of various illuminants were photographed with equal exposures both as to time and intensity. A magnesium-carbonate block was placed above, and in the same plane with, the photometer. A quartz spectrograph which has an optical system transparent to ultra-violet rays was placed with its collimator inclined toward the axis of the photometer bench, its slit receiving light

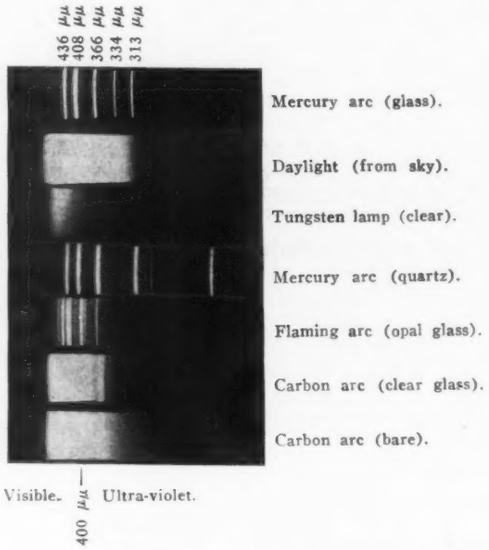


Fig. 1—Short-Wave Spectra of Various Illuminants at Equal Photometric Intensity.

from the block of magnesium carbonate. In this manner all illuminants could be balanced photometrically against a standard tungsten lamp. At the instant a balance was reached the operator could, by means of a bulb and photographic shutter, give the proper exposure. This arrangement was quite satisfactory for use with fluctuating sources. Fig. 1 shows the short-wave spectra of some of the common illuminants. The daylight used was not the direct rays from the sun, but the light reflected from the sky.

It will be noted that daylight shows considerable radiation in the ultra-violet region. In fact, examination of the

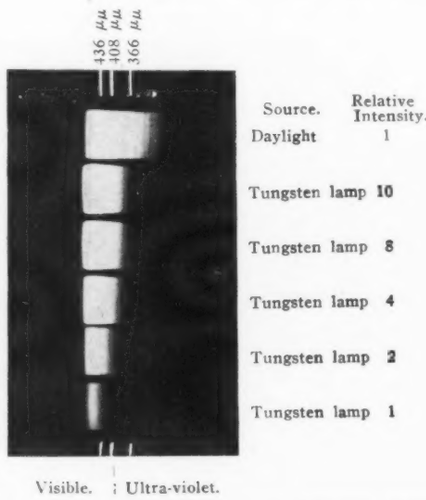


Fig. 2—Short-Wave Spectra at Various Intensities.

negatives indicates an ultra-violet radiation in daylight of the same order of magnitude as that from the artificial illuminants which are the richest in this radiation, with the possible exception of the bare quartz mercury arc and the bare carbon arc. Considering the fact that daylight illumination is usually of much greater magnitude than artificial illumination, it seems that if there are no serious

effects from the use of daylight little worry need be indulged in when using artificial illuminants as they are intended to be used. It will be noted that the carbon arc without glass radiates some extremely short-wave energy which would be very harmful. The magnetite arc whose spectrum is not shown is a very powerful ultra-violet source, but with a glass globe little danger may be expected from moderate intensities. The spectra of the Cooper Hewitt mercury-vapor lamp and flaming arc consist of energy concentrated in certain regions, but the former contains more of the harmful rays than the latter at the same photometric intensity.

Fig. 2 shows the short-wave spectrum of daylight at unit intensity compared with that of the light from a tungsten incandescent lamp at various intensities. It is seen that at an intensity ten times as great as that of sunlight tungsten light contains insufficient radiation to affect the plate an appreciable distance into the ultra-violet region.

Dr. W. Voege in the *Elektrotechnische Zeitschrift* (June 3, 1909) shows qualitatively the transmission of various kinds of glass. No quantitative results are given, therefore actual transmission curves of certain kinds of glass may prove of interest. These curves are shown in Fig. 3 for thin lead glass used in incandescent-lamp bulbs and for thin Euphos glass. The method of obtaining their transmission was photographic. The light of a quartz mercury arc reflected from a magnesia block was used as a source of ultra-violet radiation. A spectrum was formed by a small quartz spectrograph, the slit being wide enough to furnish bands from each ultra-violet line of sufficient width (about 1 mm) for photometering. A series of exposures was made, of equal length, but with different illuminations of the magnesia surface. Following those, exposures of the same length were made through the Euphos and the lead glass with known illuminations on the magnesia surface. The photographs were measured for density with a Martens polarization photometer, and curves were plotted between density and illumination for each line. From these curves the corresponding intensities of illumination (that is, transmission) were read off for each line of each negative through the specimen of glass. By taking into account the relative illuminations of the magnesia block, the transmission at each wave-length was readily obtained. The curves are not corrected for the reflection of the glass. The curves really represent the transmission minus the reflection because at the surface there was about 10 per cent reflection. The clear glass is quite transparent to

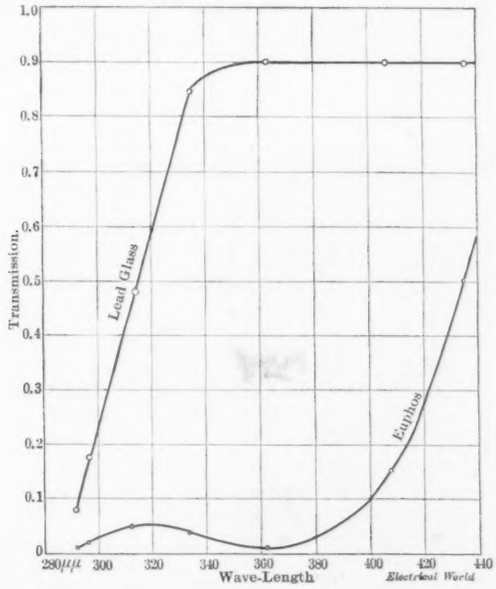


Fig. 3—Transmission Curves of Two Samples of Glass.

350 μμ, while the absorption of the Euphos specimen extends into the visible spectrum. This is shown photographically in Fig. 4. The short-wave spectrum of the light from a Nernst glower is shown through Euphos, through clear glass and bare. Clear glass begins to absorb energy at 350 μμ, and as the sun's spectrum extends to 295 μμ it is evident that glass absorbs some of the short-wave energy in daylight. This was easily verified by experiment.

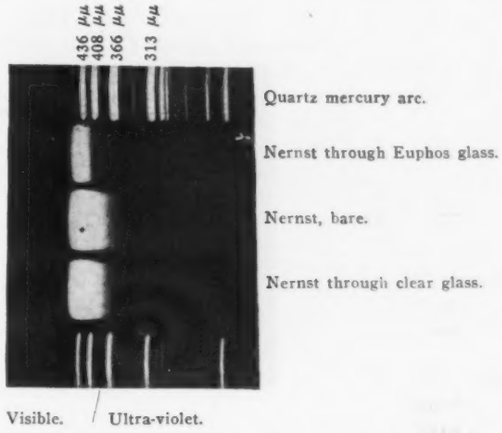


Fig. 4—Transmission of Euphos Versus Clear Glass.

Some photographic experiments with tungsten light, carbon arc (without glass) and daylight show the same general results as indicated above. For the same photographic action on the ordinary plates used it was found that the luminous intensities necessary for tungsten light, carbon arc and daylight are respectively 9, 1.5 and unity. These data were obtained with an ordinary camera with glass lenses, so that the results cannot be taken as an exact measure of the total ultra-violet radiation because the energy of shorter wave-length than 350 μμ is partially or totally absorbed.

It appears that when glass is used over any commercial light source there can be very little harmful effect when moderate intensities are used. Considering the much greater intensities of daylight, protection, if necessary in any case, is really needed against it rather than against artificial illuminants except in the case of special use of the latter light sources.

Since this article was prepared Dr. Louis Bell has published the results of an extensive research on the ultra-violet radiation from illuminants. The writer's deductions agree with the quantitative measurements by Dr. Bell with the exception of those for daylight. This difference can no doubt be accounted for by the fact that the writer used light from the sky while Dr. Bell measured the ultra-violet radiation in direct sunlight.

UNDERWRITERS' WIRING REQUIREMNETS.

The Rocky Mountain Fire Underwriters' Association has issued notices that on and after July 1, 1912, no cut-out cabinets or panelboards will be approved in installations in Colorado, Wyoming and New Mexico, except such as bear the label of the Underwriters' Laboratories, Inc. This ruling is expected to relieve the local inspection departments of a considerable burden accompanying non-uniform rulings on these devices.

The Brighton (Col.) Town Council has made effective an electrical ordinance calling for the grounding of secondaries, the use of cut-out cabinets and specifying that wiring must be done in accordance with the requirements of the National Electrical Code.

CROSS-ARMS MADE OF OLD PIPE.

On all new construction in Marion, Ind., and the surrounding towns served from its plant, the Marion Light & Heating Company is making use of iron-pipe cross-arms. These, while costing about the same as wooden arms, are expected to outlast standard construction by almost once again as many years' service. The second-hand 2-in. gas-pipe used is purchased at a junk value of 3 cents a foot and cut into 5-ft. cross-arm lengths. The metal pins are clamped to the pipe, standard wagon clips (costing 2 cents each complete with nuts) being fitted to the special galvanized pin castings produced locally for 3 cents each. The total cost of each pin is thus 5 cents. Holes are bored for the pole bolt and braces, at an estimated cost of ½ cent per hole, including handling. The brace holes, it will be observed from the illustration, are made 90 deg. from the pole bolt hole, and the braces are given a quarter turn at their arm ends so that they fit under the bolt heads. This is believed to give a neater and stronger brace construction, although it is not clear that such a quarter turn might not start a tendency to buckling of the brace. After the pipe cross-arm has been drilled and fitted, it is painted inside and out by dipping into a preservative color. Such pipe arms are expected to last twenty years or more, at the cost of a single wood arm, saving the labor cost of replacement.

When lines are to be dead-ended it is necessary to erect a double pipe-arm supporting the insulators from the top as well as the bottom. Ball strain insulators with stiff-wire jumpers may also be used, as shown in the case of the lower arm (Fig. 1). Fig. 2 illustrates an all-pipe transformer installation at Eaton, Ind., showing the primary and secondary pole-arm construction and method of wiring to transformers, as well as the arrangement of lightning arresters and fuses. The same picture shows the color scheme adopted to identify wires by the color of the insulator used. Arc lines on light-yellow insulators are seen on the two outside pins on the top arm. The three inside wires on the same arm are 2300-volt primaries carried on dark-brown insulators. The four-wire secondary circuits

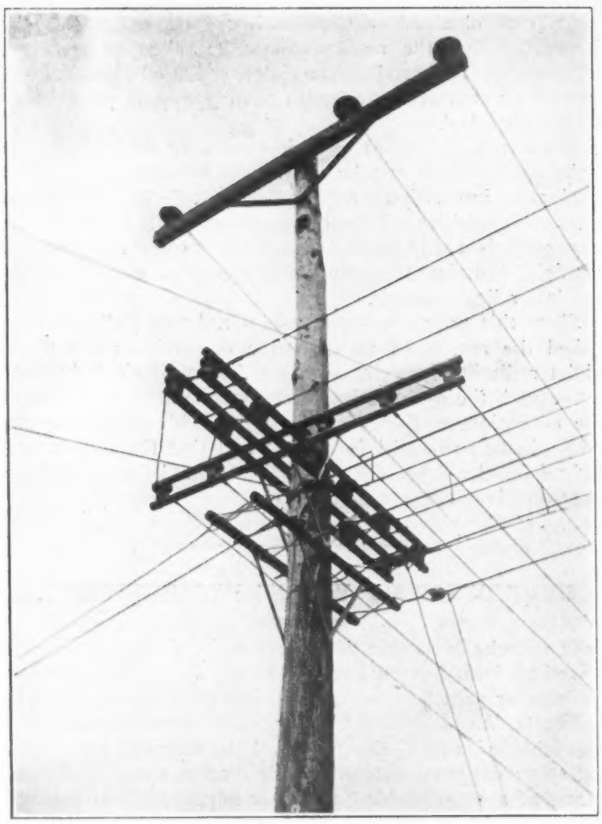


Fig. 1—Dead-End Construction with Gas-Pipe Cross-Arms.

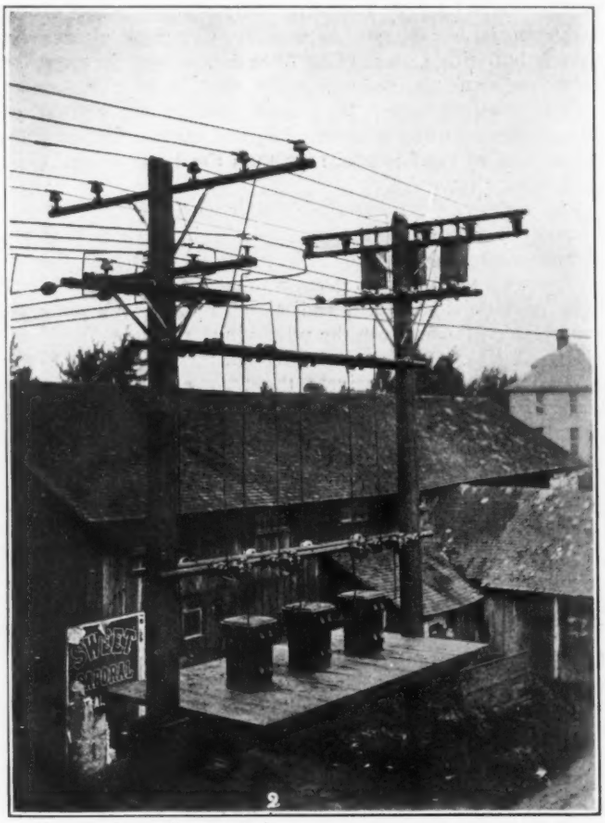


Fig. 2—An All-Pipe Installation of Transformers, Lightning Arresters and Fuses.

are mounted on white porcelain, and the ground wire is mounted on white porcelain insulators. Mr. O. M. Drischel is superintendent of construction for the Marion company.

Letters to the Editors

IMPROVED METHODS FOR THE CARE OF LEAD STORAGE BATTERIES IN ELECTRIC AUTOMOBILES.

To the Editors of Electrical World:

Sirs:—As we look back over the past fifteen years we note several events which stand out in the history of storage-battery manufacture and mark important steps in the perfection of the product. Among them may be mentioned the use of "expander" in the negative, the wood separator, the thin plate and the "Ironclad." Battery life has been increased by means of improvements in the battery itself that enable it better to withstand the treatment to which it is subjected. Except for the fact that discharge rates are somewhat lower than they used to be, this treatment is the same now as it was fifteen years ago. Instructions issued to-day by the manufacturers are in substance just what they were years ago, except that they have been expanded and clarified. In short, while marked improvement has been brought about in manufacture, there has been no improvement—or even suggested improvement—in practice. If batteries could be so treated in service as to enable them to give an increased useful life of 10 or 20 per cent—

or, again, if under certain conditions of service an eleven-plate element could be made to do all the work formerly accomplished by a thirteen-plate element—the effect on the electric-vehicle industry would be highly beneficial.

The writer wishes to state his belief that a few simple changes in the methods of charging now used (which changes result from a rational study of the subject) will produce the results mentioned above. These changes are in no wise spectacular ones, but are in entire consonance with the accepted theories that have to do with what goes on in the cell during charge. Briefly stated, the main purpose of the proposed new method is the avoidance of overcharge, which is admittedly the most important cause of deterioration. It is well known that if sufficient care is used a cell may be charged full with practically no gassing. Further than this, it is perhaps not quite so well known that with very little care and attention an almost full charge with no gassing, or a complete charge with very little gassing, may be accomplished. It therefore follows as a kind of corollary that, when the service permits, a partially discharged battery may have a large percentage of the discharged capacity put back, without gassing.

A new set of charging instruments conforming to the intent of this principle may be roughly summarized as follows:

1. In regular routine charging decrease the current toward the end of charge so as to keep below the rate that will produce gas. Experience will show what is the gassing point, which may be checked from time to time by voltage at various current values. Of course an ampere-hour meter makes charging by this method simpler, since the current may be reduced at predetermined points in the scale.

2. Once a week give the regular "overcharge," as described in any of the standard instruction books.

3. In cases where a battery has insufficient storage capacity to complete a day's work and where the noon hour or idle time is available, charge enough to make up for the lacking capacity, always remembering never to reach the gassing point.

Although experiments along these lines are by no means complete, sufficient evidence is on hand to justify the belief that the principle is a correct one.

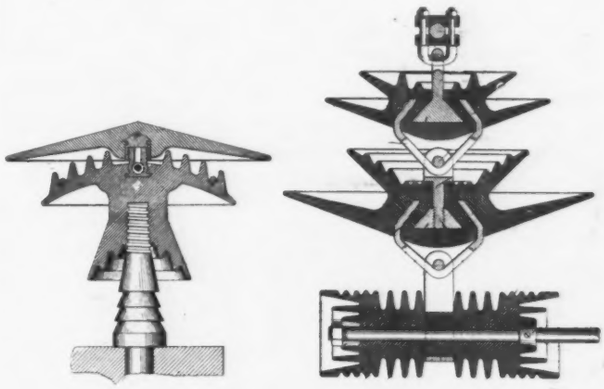
New York, N. Y. H. M. MARTIN.

GRADED SUSPENSION INSULATORS.

To the Editors of Electrical World:

SIRS:—The *Proceedings* of the American Institute of Electrical Engineers for March, 1912, contains an article by Dr. Charles P. Steinmetz, entitled "Some Problems of High-Voltage Transmission." Among other interesting facts, Dr. Steinmetz states: "With a number of equal insulating disks sharing the voltage between line and ground, the potential difference across the insulators nearest the line is higher, and the potential difference across the insulators nearest the ground is lower, than the average potential difference per insulator, the more so the greater the number of insulator disks." Also, "From this it appears that the use of a large number of small insulator disks is uneconomical at very high voltages, and a few large disks of high disruptive strength are preferable." Also, "To extend the insulating possibilities of the suspension insulator type far beyond the voltages now contemplated, therefore, requires a grading of the insulator disks in their capacity, so that the disk nearest the line has the highest, that nearest the ground the lowest capacity, or the addition of capacity at the surface of the insulator disks, in proportion to their distance from the ground." It will no doubt be of general interest to learn that I worked out those theories some years ago, and embodied them in a patent issued Feb. 15, 1910, No. 949,604, the application for which was filed Dec. 4, 1909.

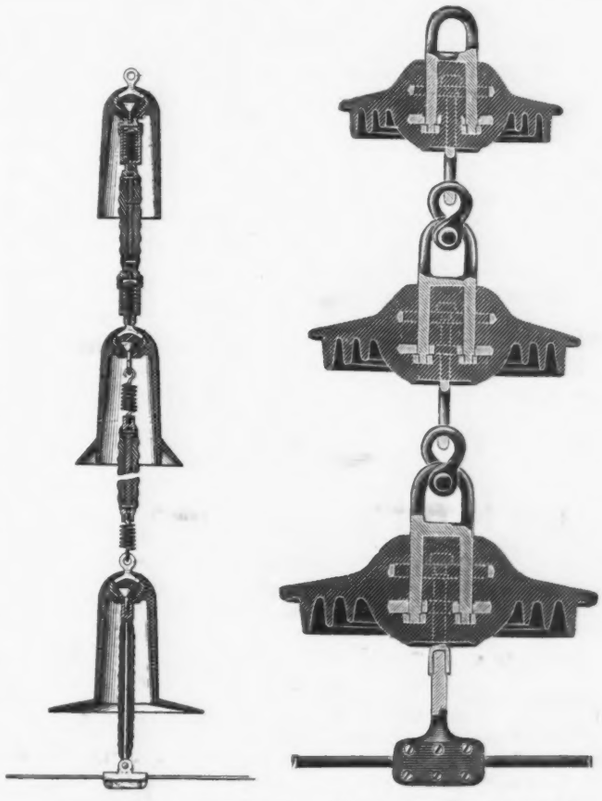
This patent covers a number of new and very desirable features. In this patent, in place of disk-type insulators, I employed my then newly invented "thimble type" insulators. The title "thimble type" was coined to denote the general



Figs. 1 and 2—Patents Nos. 879,068 and 905,014.

thimble form of the insulator body, to distinguish them from disk or hood-type insulators.

My earlier patents, No. 879,068, of Feb. 11, 1908, and No. 905,014, of Nov. 24, 1908, show that some years prior to the time of filing application for Patent No. 949,604, of Feb. 15, 1910, I was working along lines the very opposite of my later inventions. The two earlier patents show that I then believed it advisable to protect the lower insulator unit by placing a larger unit above it or by providing a separate



Figs. 3 and 4—Patent No. 949,604 and Modification.

shed or umbrella-like member above the lower insulator unit.

I have been greatly pleased to learn that others have recently arrived at conclusions reached by me several years earlier.

Brooklyn, N. Y. LOUIS STEINBERGER.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

The Vibrator; a Dynamo-Electric Condenser as a Phase Advancer.—Gisbert Kapp.—The conclusion of his paper on phase advancers for non-synchronous machines. In a non-synchronous machine the rotor current and rotor flux are in time quadrature, and if the rotor current is made by some means to lag less than 90 time deg. behind the flux,

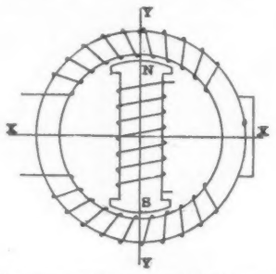


Fig. 1—Diagram of Dynamo-Electric Condenser.

the phase of the stator current is advanced, there is an improvement in the power-factor and an increase in the overload range. This can be accomplished by injecting a suitable emf into the rotor of the non-synchronous motor. The author describes the "vibrator" which he has devised for this purpose. In Fig. 1 a ring is wound so as to produce a magnetic axis on the line *X X* and within the ring is placed a bar magnet *NS*, to which by means of a spring, weight or a weak direct-current winding on the ring a normal or zero position along the axis *Y Y* is secured. This directing force is made so feeble that it may be neglected in comparison with the force exerted on the poles of the magnet by a current traversing the main winding on the ring. A current flowing through the winding exerts a turning couple on the magnet, the sense changing with the direction of the current. If then an alternating current of the low frequency of the slip be sent through the coil, the magnet will be set into vibration symmetrically in regard to its zero position. If the mass of the magnet is large enough, the deflections of the magnet to either side will be reduced so that the poles never pass outside of the influence of the winding. As the poles sweep past the stationary coils they induce in them an emf the magnitude of which is at any moment proportional to the speed. This emf is in time quadrature with the current and is leading before the current so that the

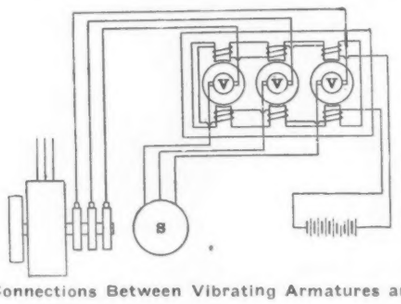


Fig. 2—Connections Between Vibrating Armatures and Motor.

machine can be used as a phase advancer if inserted into the rotor circuit between slip ring and the usual starter. For practical purposes, however, it is advisable to reverse the function of the fixed and swinging parts, by making the direct-current field the fixed part and the alternating-current winding the swinging part. The latter then simply takes the shape of an ordinary direct-current armature which receives the alternating current by means of brushes and a commutator. The mass may be reduced by making the armature long in comparison to its diameter. This introduces the use of a commutator, but there is absolutely no danger of sparking. The connection between the vibrating armatures and the motor is shown diagrammatically in Fig. 2. The armatures *V V V* are housed in one common magnet frame, the poles being excited by a battery or any other convenient source of direct current. The power required for excitation is only a fraction of 1 per cent of the power of the motor, and the loss of power by winding and brush resistance in the armatures is of the same order of magnitude. Against this must be set the reduction of copper heat in the primary of the motor, so that practically the total efficiency of the motor will be the same with or without vibrator. As shown in Fig. 2, the vibrator is interposed between the slip rings and the usual starter *S*. It is advisable to put in a short-circuiting switch (not shown) so that the vibrator is out of action during the starting period. The theory of the vibrator is given in some detail.—London *Electrician*, May 24, 1912.

Large Direct-Current Generators for Electrochemical Purposes.—H. Daeschler.—An illustrated description of large direct-current generators built by the Oerlikon company for electrochemical plants. Details are given of the design of a generator dynamo running at 300 r.p.m. with a normal rated output of 3000 kw for continuous operation day and night. The power for driving is 4400 hp. The normal current is 8000 amp and the emf 375 volts. The overload rating is 15 per cent for two hours and 35 per cent for one-half hour. The voltage can be raised to 390. The efficiency at full load is 95 per cent, the maximum temperature rise in continuous operation is 45 deg. C. The total weight is 5400 kg.—*Elek. Zeit.*, May 23, 1912.

Three-Phase Series Commutator Motor.—M. Schenkel.—The conclusion of his long illustrated description of the three-phase series commutator motor with special reference to the improvements made by the Siemens-Schuckert company in the provision of a double set of brushes. In the present instalment it is shown that breaking of this motor is possible with a return of considerable useful energy to the network. The favorable commutation conditions of this motor are discussed and several practical types of construction are described.—*Elek. Zeit.*, May 23, 1912.

Lamps and Lighting.

Temperature and Efficiency of Incandescent Filaments.—W. E. Forsythe.—Of all the ways in which "efficiency" might be defined, there are two ways which suggest themselves first, the one being purely physical and the other physiological. The first is what has been called "radiant efficiency" and is defined as the ratio L/R, where L is the visible radiant energy and R the total radiant energy. The second is the one used by the engineer, that of candle-power per watt, which is really a specific output and means how much "light" in some arbitrary unit (candle-power) is obtained for each watt of power consumed. In the present paper the author gives the results of a determination of the two "efficiencies" just defined of tungsten, tantalum and carbon filaments in commercial incandescent lamps. The radiant efficiency was determined by a modification of Angstrom's method. The tungsten filaments were from a General Electric lamp, the tantalum filaments from a Siemens & Halske lamp, the carbon filaments from a Peerless lamp and the metallized carbon filaments from a General Electric lamp. The temperature of the filaments in the lamp bulbs was also determined. The results are given in the table which is printed on the following page.

(It will be seen that the values of radiant efficiency are by no means exactly proportional to those of candle-power per watt. The ratio of the radiant efficiencies of tungsten to tantalum to gem to carbon is 100 to 82.7 to 61.5 to 48.1,

TEMPERATURE AND EFFICIENCY OF INCANDESCENT FILAMENTS.

Lamp.	Normal Temperature.		Radiant Efficiency, per Cent.	Candle-Power per Watt.
	Black Body $\lambda = 0.658\mu$	True.		
Tungsten.....	1912	2032	5.2	0.890
Tantalum.....	1795	1945	4.3	0.655
Gem.....	1865	.....	3.2	0.430
Carbon.....	1800	1845	2.5	0.368

while the values of candle-power per watt have the relation of 100 to 73.6 to 48.3 to 41.3.) The author also determined the radiant efficiency of the different filaments as functions of the temperature. The results are given in Fig. 3, where the curves 1, 2, 3 and 4 on the left hand give radiation

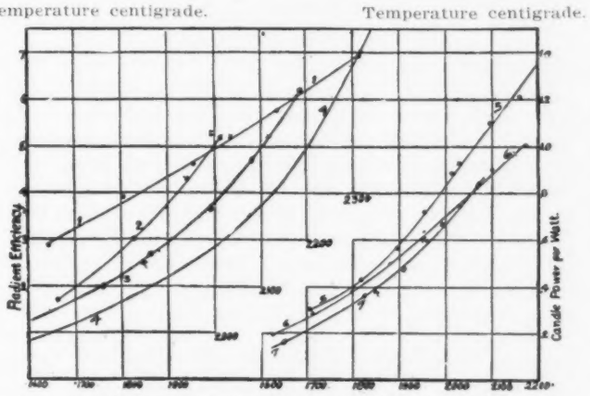


Fig. 3—Relation Between Radiant Efficiency of Different Filaments and Temperature.

efficiencies, 1 for tungsten, 2 for tantalum, 3 for carbon and 4 for the black body, while the curves 5, 6, 7 on the right hand give the candle-power per watt, 5 for tungsten, 6 for tantalum and 7 for carbon. The arrows indicate commercial brilliancy.—*Phys. Review*, May, 1912.

Osram Lamp Patent Suit in Great Britain.—All the London electrical journals have contained long accounts of the extended patent suit during the last weeks, and an account is now given of the judgment delivered in the case brought by the Osram Lamp Works against the "Z" Manufacturing Company for infringement of three of their patents. The first patent, due to Just and Hanaman, was for metallic filaments made from powdered tungsten and an organic binder, the filaments being subsequently baked, sintered and heated electrically in an atmosphere of steam and hydrogen in order to remove the carbon, and finally in an atmosphere of some volatile tungsten compound, this being equivalent to the flashing of a carbon filament. The second patent was due to the Auergesellschaft and had for its object the use of ammonia as an atmosphere in which to remove the carbon from the filament, an oxidizing agent, such as steam, being thus avoided and the carbon being converted into cyanogen. The third patent, due to the same company, was for the loading of metallic filaments during the process of sintering, such loading giving a more uniform filament. The court found that the plaintiffs have been successful in proving infringement against the first patent, but not against the second, and the third patent has been declared invalid. The present case is of great industrial importance because, if the judgment is upheld, it gives the (British) General Electric Company a very large control of the metallic-filament lamp industry in England. It is stated that cross appeals are to be made.—Lond. *Electrician*, May 24, 1912.

Illumination.—An illustrated article by C. E. Clewell deals with the installation of industrial lighting systems (general illumination drawings which should be followed carefully by the wiremen, ceiling construction, method of switch control, maintenance, separate lighting circuits, wiring, multiple versus series systems in the shop). Another article by E. B. Rowe gives an outline of a method of calculating illumination on the basis of light flux.—*Elec. Journal*, June, 1912.

Generation, Transmission and Distribution.

Norwegian Water-Power Plant.—MARGUERRE.—A continuation of his long illustrated article on the Rjukanfos water-power plant. In the present instalment a description with drawings is given of the switchboard arrangements and the wiring.—*La Lumière Elec.*, May 11, 1912.

Gear Data.—C. W. DRAKE.—An article giving a diagram for determining the dimensions of steel pinions from the horse-power and speed of the motor with notes on the limit set by noise, etc.—*Elec. Journal*, June, 1912.

Traction.

Rectifier Locomotive for Single-Phase Lines.—An illustrated description of a locomotive built by the Alioth Company for a French railroad. Single-phase current is taken from an overhead line at 12,000 volts pressure with a frequency of 25, and the pressure is reduced by transformers on the locomotive to that necessary to supply the rectifiers. The special feature is the design of these rectifiers, which is due to Auvert and Ferrand and has already been described in the *Digest*. The rectified current is supplied normally at 600 volts pressure to the two motors of each half of the locomotive, the latter consisting of two similar truck frames and bodies connected by a single central coupling. The two motors of each half are of 400 hp each and are connected in series. From results obtained it appears that the starting up of this locomotive is rapid and very regular. The power-factor even at the commencement of movement of the train is maintained at above 0.50. The efficiency of the whole locomotive, that is of the combined apparatus, is from 78 to 90 per cent. The chief points claimed for this system of rectified current electric drive are flexibility of control and working and high efficiency.—*Le Génie Civil*, Feb. 17, 1912; Lond. *Elec. Review*, May 24, 1912.

System of Electrification of Railways.—O. C. ROEDDER.—A general article on the choice of the system in the electrification of railways, emphasizing that progress of the direct-current system has been comparatively more satisfactory in recent years than that of the single-phase system.—*Elek. u. Masch.* (Vienna), May 12, 1912.

Installations, Systems and Appliances.

Electric Supply in Country Districts.—An illustrated article on the supply of electricity in the scattered country districts of Staines and Egham in England. The supply station is at Egham and contains two Diesel engines coupled to 94-kw, 2000-volt, single-phase alternators. There are two distribution lines to the Staines and the Egham district. A 20-kw transformer is placed in each town. A large part of the distribution, however, is by high-tension mains with transformers on consumers' premises. The usual rate of charging is by a two-rate meter, the charge for energy being 4 cents per kw-hr., except during a few hours at peak load—namely, between 5:50 p. m. and 8:50 p. m. in winter and 8 p. m. and 11 p. m. in summer, when 14 cents per kw-hr. is charged. As no distinction is made as to the purpose for which energy is used, great encouragement is given to electric heating and cooking. A flat rate of 12 cents per kw-hr. is also offered. Consumers, however, generally prefer the two-rate method of charging. The meter rent is 62 cents per quarter with the flat-rate method, and in the case of the two-rate system $1 per quarter owing to the cost of the time switches.—Lond. *Electrician*, May 24, 1912.

Wires, Wiring and Conduits.

Planning of Distribution Networks.—Carl Schmidt.—The author points out some general and universally applicable viewpoints which may be used in planning new distribution networks of central stations or the extension of existing ones. Even if there are only very indefinite data available on the probable consumption and maximum load, yet it is possible to plan the distributing network according to these fundamental viewpoints so that they satisfy at any time the requirements of the situation. The capital invested corresponds at any time to the extension and maximum load of the network at that time.—*Elek. Zeit.*, May 23, 1912.

The Solution of Network Problems.—R. Appleyard.—An abstract of a London Physical Society paper on the solution of network problems by determinants. Let it be supposed that cyclic currents have been assigned to all the meshes of a given network, and that all capacities (K, in farads), inductances (L, in henries) and leakances (S, in mhos) have been converted into resistances in ohms $\left(\frac{1}{Kip}, Lip, \frac{1}{S}\right.$ where $p = 4\pi$ times frequency.) The general network problem then is to find the current, in amperes, in any given branch, corresponding to the application of an emf of sine form between any two fixed points in the network. The procedure for solving such a problem may be summarized as follows: (1) Denote the cyclic current in the mesh on one side of the given branch by, say $(X + Y)$, and the cyclic current in the mesh on the other side of it by, say, Y, so that X is the magnitude of the real current through the given branch. (2) Number the meshes in consecutive order, beginning at the generator mesh and ending at the $(X + Y)$ mesh. Let the Y mesh be next to the last. (3) Write down successively the total resistance of each mesh in the order of their numbers—including capacities, inductances and leakances, converted into resistances as above—and make these values the successive terms of the leading diagonal of a determinant, beginning at the top. Observe that the order of the columns of the determinant is now the same as the order of the meshes. So also is the order of the rows. (4) To fill up any given row (or column), say the nth, observe what are the resistances of the branches crossed in passing from the nth mesh successively to the first, second, third . . . mesh, and make these values the respective constituents of the first, second, third . . . places in the nth row. The nth constituent of the nth row will always be in the leading diagonal, and to it a plus sign is to be given. All constituents outside the leading diagonal are to be given a minus sign. (5) Now replace the $(X + Y)$ and (Y) columns of the determinant so formed by columns corresponding only to X and Y. To do this, add the $(X + Y)$ column to the Y column to form a new Y column and retain the $(X + Y)$ column for a new X column. This is equivalent to multiplying out the fundamental mesh equations and bringing all terms in X inside one bracket and all terms in Y inside another bracket. The final column now corresponds with X and the penultimate column with Y. The determinant Δ_n is thus completed. (6) Replace the final column by $E, 0, 0, 0, 0, \ldots$ putting E at the head of the column. Expand the determinant so formed, in terms of $E, 0, 0, 0, 0 \ldots$ and it becomes $E\,\Delta_{n-1}$. In general this operation may be omitted, since Δ_{n-1} can at once be written down when operation (5) is completed. (7) Then, by the well-known property of determinants, $X = E\frac{\Delta_{n-1}}{\Delta_n}$, and the resistance r, between the two points of the network to which E is applied, is $r = \frac{\Delta_n}{\Delta_{n-1}}$. (8) If the network contains mutual inductances, a convention must be adopted in respect to signs. Regard each mutual inductance as a pair of parallel straight conductors; then a sudden increase of current in one conductor will induce in the other a momentary current in a direction opposite to that in the first. If this induced current is in the same direction as the cyclic current of the mesh to which the second conductor belongs, then the mutual inductance term Mip is to be regarded as plus, and if the induced current is in the opposite direction to that cyclic current Mip is to be regarded as minus. (9) Observe that there can never be an M term in the leading diagonal. There is, however, always an M term in a constituent outside the leading diagonal, provided that the constituent corresponds to a mesh linked by mutual inductance to a mesh in which there is a varying current. (10) This method of solution is based upon the assumption of a sineform emf of definite frequency, and consequently all the constants of the meshes are effective values corresponding to the selected frequency. If the conditions of equilibrium in any particular case do not explicitly contain a frequency term, the current wave may be of any shape, and under these circumstances the method applies to a current impulse of any form whatever. —London *Electrician*, May 17, 1912.

Electrochemistry and Batteries.

Recovery of Lead Sludge from Storage Batteries.—A note stating that the sludge of lead peroxide and sulphate which collects in the course of years in storage batteries has a value in view of its lead content. But on account of the associated acid it is difficult to transport it to smelters. Washing and pressing are out of the question, mainly on account of the extremely fine state of division of the peroxide. According to a German patent (No. 236,343) these difficulties are overcome by mixing the sludge with slaked lime. The resulting mixture quickly sets to a firm cake. An alternative plan is to mix the sludge with the sulphite liquor from sulphite cellulose works, the lead peroxide being thus reduced to lead sulphate. Molasses may also be used for the reduction of the peroxide. In all these reactions so much heat is set free that much of the water is evaporated.—London *Electrician*, May 24, 1912.

Units, Measurements and Instruments.

Hot-Wire Ammeter for High Frequency Currents.—J. Reyval.—At the recent exhibition of the French Physical Society a hot-wire ammeter for high-frequency currents, shown in Fig. 4, was exhibited. The wires F are symmetrically arranged around a cylinder between the disks A and B and at their center carry the disk D with lever L.

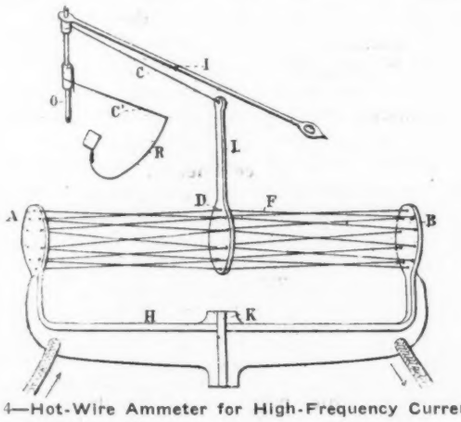


Fig. 4—Hot-Wire Ammeter for High-Frequency Currents.

Equal currents pass through the wires F and heat them. When they expand the disk L, on which the spring R acts through the intermediary of the axle O, is deflected and causes a deflection of the needle I. Since all wires F act in the same way, the available force is quite great. The frame H which carries the disks A and B is made of the same conducting material as the hot wires F to eliminate the effect of the temperature of the surrounding atmos-

phere; it is cut in the center and its right and left halves are separated from each other by the insulating layer *K* to force the current to pass through the wires *F*.—*La Lumière Elec.*, May 11, 1912.

Exhibition of Instruments.—J. REYVAL.—The conclusion of his long illustrated article on the exhibits of instruments and apparatus at the recent exhibition of the French Physical Society.—*La Lumière Elec.*, May 11, 1912.

Telegraphy, Telephony and Signals.

Impact Excitation.—E. L. CHAFFEE.—A long Franklin Institute paper illustrated by diagrams on a new system of impact excitation of continuous electrical oscillations and their application to wireless telephony. The new system depends in its action upon the properties of a special discharge gap when working in conjunction with properly adjusted circuits. The primary circuit executes rectified impulses of approximately double the period of the secondary oscillation. Because of this fact, because of the particular shape of the primary impulses, and because of the fact that these impulses occur automatically in the proper phase relation with the secondary oscillations, the latter are sinusoidal in form, are continuous, and, if the primary impulse frequency be sufficient, are constant in amplitude. Although this system is not an arc system, yet the resulting oscillations possess the continuity of the arc oscillations, but with a greater constancy of wave-length and an improvement of wave-form.—*Journal Franklin Inst.*, May, 1912.

Improvement of Insulation Resistance of Paper-Insulated Telephone Cables.—E. WINTERER.—Barbarat introduced the use of paper-insulated, lead-covered cables in which the insulation resistance was maintained high by employing dry air under pressure within the lead cover. In case the insulation resistance of such a cable was reduced by humidity entering into the lead cover, it could be restored to its former value by passing through the cable a current of carefully dried compressed air. The use of compressed air has some inconveniences, and the present author uses instead thereof liquid carbon dioxide with good success. Some details of its application are given.—*Annales des Postes, Télégraphes et Téléphones*, March, 1912; *La Revue Elec.*, May 10, 1912.

Wireless Telegraph Compass.—An illustrated description of some details of the Telefunken "compass" by means of which a ship can determine its position. Signals are being sent from directive-antenna stations along the coast, and the attendant on board ship finds the position by determining the maximum sound in the acoustic receiver.—Lond. *Electrician*, May 24, 1912.

Wireless Telegraphy.—S. KIMURA.—A mathematical paper on one-waveness in wireless telegraphy and pseudo-impact excitation.—*Phys. Review*, May, 1912.

Miscellaneous.

German Electrical Stock Companies in 1909-10.—An abstract of a report of the German government Statistical Bureau on electrical stock companies in 1909-10. There were forty companies manufacturing electrical goods and eighty-one companies generating electrical power. The capital invested in the former was $57,000,000 and in the latter $172,000000. Thirty-six manufacturing companies produced net profits, the total being $5,500,000, and sixty-nine power companies produced net profits, the total being $16,700,000. Four manufacturing companies had a total net loss of $300,000. Ten power companies had a total net loss of $500,000. Dividends were declared by thirty-four manufacturing companies and sixty-three power companies. The dividends paid out were 7.82 per cent of the capital stock in the case of the manufacturing companies and 8.64 per cent of the capital stock in the case of the power companies.—*Elek. Zeit.*, May 23, 1912.

British Institution of Electrical Engineers.—An account of the proceedings at the fortieth annual meeting of the (British) Institution of Electrical Engineers. A South African local section is to be formed, as well as a Canadian local section. The latter "should prove of considerable value to the Institution; but it must be borne in mind that it would have to compete to some extent with the American Institute of Electrical Engineers, which holds a strong position in Canada." At May 1, 1912, the membership of the Institution totaled 6537, comprising seven honorary members, 1388 members, 3089 associate members, 806 associates and 1247 students. The additions during the year total 984, and the deductions 680. An account of the presentation of a Kelvin bust to the Institute by Lady Kelvin is also given.—Lond. *Electrician*, May 23, 1912.

Electrical Factory.—An illustrated description of the works of the India-Rubber, Gutta-Percha and Telegraph Works Company, Ltd., Silvertown, London, and its various lines of manufacture.—Lond. *Elec. Review*, May 24, 1912.

Laboratory.—An illustrated description of the Liverpool University School of Engineering.—Lond. *Electrician*, May 24, 1912.

Book Reviews

LA COSTRUZIONE DELLE LINEE ELETTRICHE AEREE. By I. Brunelli. Roma: Stabilimento Cromo-Tip. di Carlo Colombo. 313 pages, 74 illus. Price, 7.50 lire.

A good textbook on pole-line construction from the mechanical engineering standpoint. The book is written by an engineer for engineers. It is a theoretical treatment of the strength and mechanical properties of pole lines, while at the same time it contains some very practical information concerning the costs of erection and maintenance. There are very few illustrations of actual pole lines or pole construction. Nearly all the illustrations are stress diagrams. The book will be very useful to advanced students of pole-line construction theory and also to those who are interested in aerial line constructions as carried out in Italy. The mathematical treatment is able and clear.

POWER HOUSE DESIGN. By John F. C. Snell. London: Longmans, Green & Company. 430 pages, 17 folding plates, 186 illus. Price, 21 shillings.

A carefully prepared textbook of power-house design, especially from the constructing engineer's standpoint and with particular reference to British practice. The twelve chapters of the book relate to the following subjects: Systems, sites and types of plants, buildings, steam-raising plant, steam and feed-pipe systems, steam generators, condensers, internal-combustion engines, hydroelectric power houses, power-house switchgear, practical notes on electrical plant, small power houses and substations. The book is clearly written and well illustrated. There are numerous illustrations from plants in various parts of the world. It will be useful as a reference book to station designers everywhere.

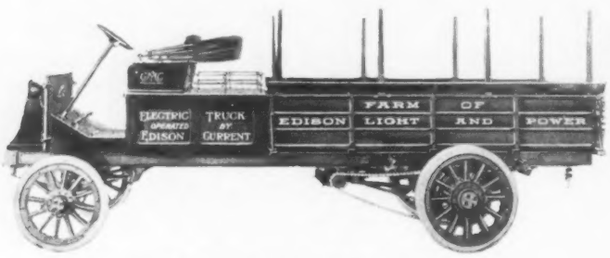
QUALITATIVE ANALYSIS. By Arthur E. Hill, Ph.D. London: Williams & Norgate. 76 pages. Price, $1.

A brief laboratory guide intended either for the use of students in elementary qualitative chemical analysis or for those persons not trained chemists who may wish intelligently to attempt qualitative analysis with the aid of ordinary chemical apparatus and reagents. The scheme pursued in the book is very clearly mapped out and described. Very little space is given to explaining in detail the reactions which occur. The correct procedure, the indications and the deductions are the principal objects in view. All the substances tested are classified into five groups for this purpose. The book will commend itself to the practical man and to the elementary student of chemistry.

New Apparatus and Appliances

ELECTRIC TRUCK FOR FARM SERVICE.

An interesting institution known as the "electric farm" is located in the outskirts of Boston and operated by the Edison Electric Illuminating Company of Boston. Electricity does everything on this up-to-the-minute establishment. It cuts the fodder, milks the cows, washes the dishes, pumps the water, churns the butter and finally takes the product of the farm to the city in an electric truck. The farm is thoroughly electrified and is attracting considerable attention, for thousands of Boston people visit it every week. Use is made of the 2-ton truck herewith illustrated, which was built by the General Motors Company, Detroit, Mich.



Electric Truck for Farm Service.

ELECTRICALLY OPERATED SWING-SPAN BRIDGE.

The International Bridge over the government's new five-million-dollar ship canal at Black Rock, N. Y., is one of the longest and heaviest single-span bridges on the continent, being 431 ft. 5 in. long and 29 ft. wide, and weighing 4,500,000 lb. It provides for the operation of trains over a double track and for electric cars and pedestrian traffic. The bridge was erected at a cost of $500,000 and is used by five trunk lines.

The bridge is operated by electricity and can be swung in seventy seconds. The two turning motors are of the Westinghouse 53-hp street-car type. In addition there are two end lift motors of 15 hp each and two smaller motors of 5 hp each to operate the rail wedges. A small compressor supplies air for operating the end lock and band brakes. All are controlled from the operator's house above the deck of the bridge. By use of contactors which are controlled by sliding contacts connected to the end mechanism, to rail wedges and to drum of the bridge, it is impossible for the operator to make an error in opening the bridge. The energy for the end lift motors can be had only after the rail wedges have been drawn. Likewise the energy for the turning motors cannot be had till the ends have been sufficiently raised. In closing the bridge the above operation is reversed.

To supply energy for the bridge the Grand Trunk Railroad Company erected a power house at a cost of $25,000. To make sure there will always be energy available for turning the bridge the following apparatus has been installed: One 255-cell Gould storage battery having a rating of 60 amp at the eight-hour basis; one 100-hp Otto gas engine directly connected to a 60-kw commutating-pole Garwood generator; one Garwood generator set of 60 kw, directly connected to a 2200-volt induction motor driven by energy transmitted from Niagara Falls.

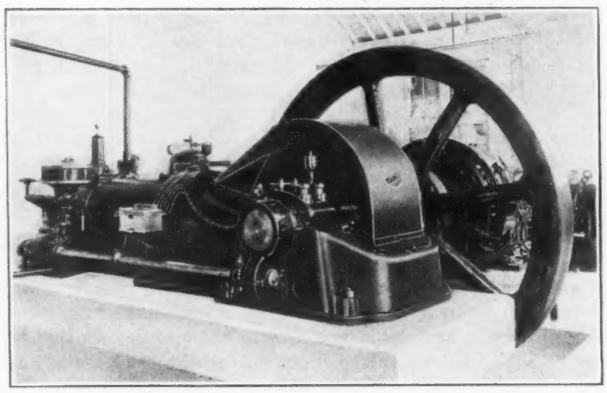


Fig. 2—Gasoline Engine Generating Equipment.

The switchboard was furnished by the Robertson-Cataract Company, Buffalo, N. Y. One of the men about the yards visits the station at certain periods and from the instrument on the board ascertains whether or not it is necessary to replenish the supply of electrical energy in the storage batteries.

It is possible to form any desired combination; that is, to run both generators to supply energy directly to the bridge, or charge the storage battery with one generator and operate the bridge with the other, or operate the bridge from the storage battery, or, if it should for any reason be necessary, parallel both generator and the storage battery, thus giving an output of over 400 hp for a limited time. One man starts the gas engine with perfect ease. It is equipped with automatic and force-feed oiling system. The following data obtained from a number of tests that have been made show the energy required for the operation of the bridge and its cost:

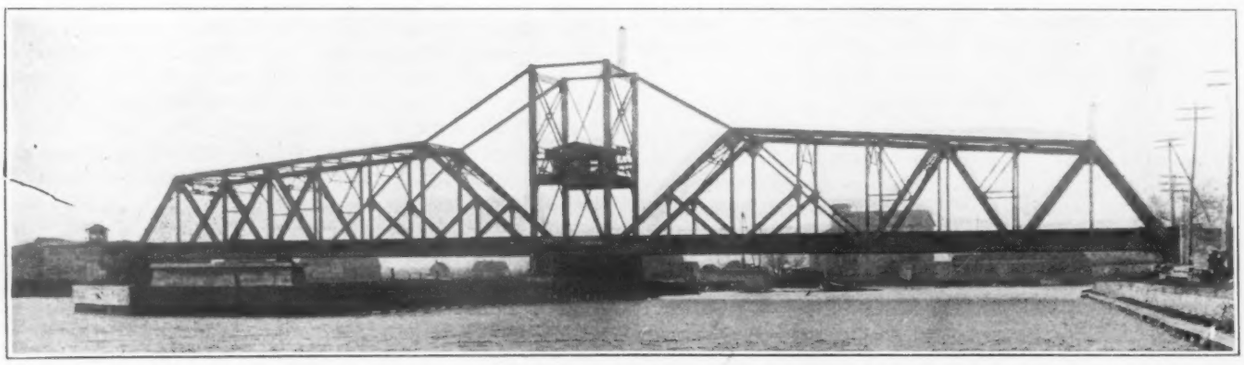


Fig. 1—Motor-Operated Swing-Span Bridge.

Energy required on the bridge: For navigation lighting, operator's house and deck of bridge, seventeen 16-cp lamps operating twelve hours per day, or 52.02 kw-hr. For signal lighting, sixteen 8-cp lamps, half of which are in service at once and then only when the bridge is swung. With ten swings per day of ten minutes' duration the energy required is 1.60 kw-hr. Energy for withdrawal of rail and insertion of wedges, for ten swings, 2.24 kw-hr. Energy for operating end lifts of bridge, for ten swings, 0.672 kw-hr. Energy for motor-driving the air compressor used to operate latch, whistle and band brakes, for ten swings, 3.820 kw-hr. The total energy used on bridge for all purposes for one day, assuming ten swings, was 73.722 kw-hr. The above readings are the average of a number of tests made on Sept. 3, 1911.

On Aug. 25, 1911, tests were made to determine the cost of generating energy with the gas-engine set for the purpose of comparison with the cost of purchasing transmitted energy. The engine set was used to charge the battery with a constant current of 60 amp at an emf varying from 545 volts to 660 volts, the average observed from a recording voltmeter chart being 602 volts. For supplying 208.35 kw-hr. to the battery 2608 cu. ft. of gas was used, the cost of the gas being $0.782 at 30 cents per 1000 cu. ft. The cost of labor for three hours was $0.90, the oil cost $0.20 and the water $0.12. The total cost was therefore $2.002, or 1.84 cents per kw-hr. With an assumed energy loss of 15 per cent in the battery the total energy required per month would be 2601.96 kw-hr. and the cost $47.87, to which must be added interest on the gas-engine unit of $27, making the total $74.87.

Assuming now a total loss of 30 per cent in transforming the transmitted energy from three-phase to direct current, the energy required per month would be 3159.51 kw-hr. With a cost of 1 cent per kw-hr. and a fixed service charge of $50 per month, the energy cost would be $81.60, to which must be added wages of $18 and interest on motor generator set of $15, making a total of $114.60, as compared with $74.87 when the gas-engine set is used as the source of energy. Thus there is a saving of $39.73 per month by using the gas-engine set.

The above-described equipment arrangement was planned by Mr. H. G. Kelly, chief engineer of the Grand Trunk Railway System, and Messrs. E. W. See and R. D. Garner, assistant engineers. The electrical engineer was Mr. J. H. Burnett. The general contractors for the power plant were the Otto Gas Works, Philadelphia.

REMOVABLE-PANEL IRONCLAD SWITCHBOARDS.

The switchboard illustrated herewith differs in several important details from standard types of switchboards utilized in America. The front of the board itself is built up of sheet iron which carries the meters and switch-operating handle, while the switch gear and reducing transformers are placed inside of the framework on the rear of the panel proper. The oil switch is carried on iron bars attached to the side frames, and the series or shunt instrument transformers are likewise attached to the side frames. This arrangement is essentially different from the one employed in America, where use is ordinarily made of insulating material for the front of the switchboard panel.

A feature worthy of special note is the removable-panel arrangement. Each panel is mounted on wheels which stand upon rails in the base of the fixed framework, and each panel is capable of being withdrawn separately upon a light portable track which is laid down temporarily as a continuation of the fixed rails. The design is such that when a panel is withdrawn from the fixed framework no part of the switch gear or apparatus carried by the panel remains alive. The only live parts are three protected sockets inside and at the back of the fixed framework. As the contacts of these sockets are fully recessed in heavy porcelain insulators, there is no possibility of their being accidentally touched. An advantage of the removable-panel arrangement as compared with the fixed-panel arrangement resides in the fact that the repairs and alterations can be made at the switchboard while the plant is still in active operation.

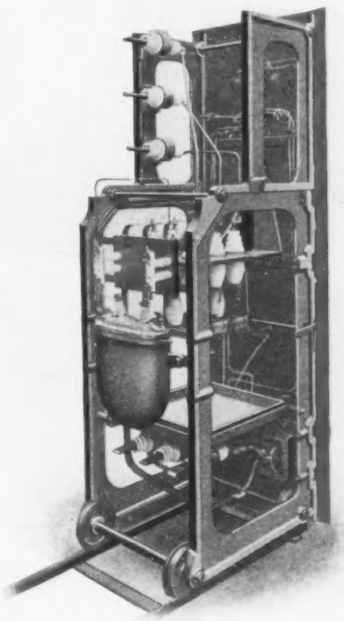


Fig. 1—Rear of Removable Panel.

Thus a minimum of trouble and cost is involved in periodic examination, cleaning, repairing and adjusting. All of these operations can be performed with the panel drawn forward so as to be clear of all obstructions, where the apparatus contained on the panel becomes accessible from all quarters instead of from only one side as in the ordinary fixed-

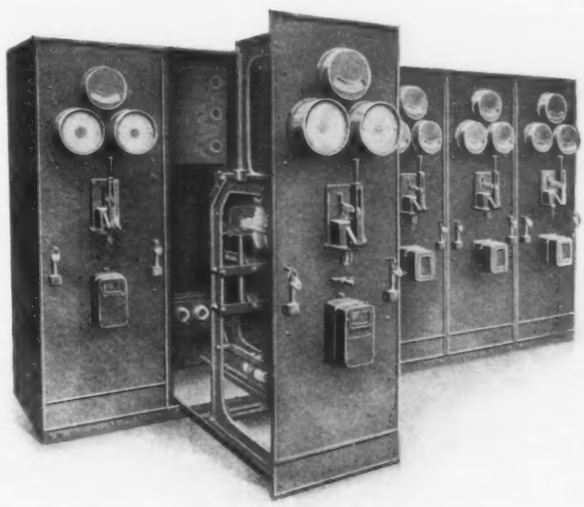


Fig. 2—One Panel Being Removed from Switchboard.

panel arrangement. Although the first cost of a removable-panel board is more than that of the usual fixed-panel equipment, yet it is claimed that the extra cost is rapidly repaid by the saving in labor charges for cleaning and examination. The switchboard described above has been developed by the Electrical Construction Company, Ltd., No. 9 New Broad Street, London, E. C.

PORTABLE METER-TESTING RHEOSTAT.

In the load rheostat herewith illustrated the resistor wire is wound on a light fireproof base and is covered with a special cement to prevent shifting or mechanical injury. The terminals are so located that there is no danger of

Portable Meter-Testing Rheostat.

making a mistake in connecting. The switches, mounted on asbestos lumber, are of the single-pole type in which the blade is guided into the clip. For carrying, the feet are folded over the frame and held by a latch. The weight of the bench type shown in the accompanying illustration is only 13 lb. This type of rheostat has been designed for testing watt-hour meters on the premises of the customers. It has been placed on the market by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis.

MAXIMUM-DEMAND INDICATING DEVICE.

In cases where the income from a customer will not warrant the expenditure for instruments giving complete records the maximum-demand indicator used in connection with a watt-hour meter has proved a convenient arrangement for certain rate schedules. The description of such a device, called the maxicator, will be found in the issue of the *Electrical World* for March 30, 1912. In the following is described and illustrated an indicator called a maximeter, which may be used for loads under 50 hp and in connection

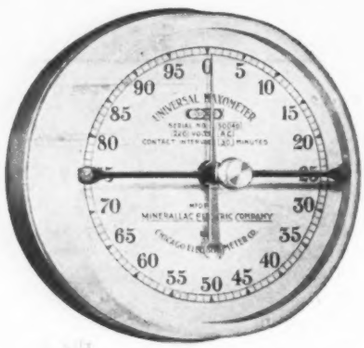


Fig. 1—Maximum-Demand Indicator.

with any watt-hour meter exclusive of those to which the above-mentioned maxicator is directly applicable.

The instruments are interlocked electrically instead of mechanically and clock mechanism is entirely eliminated in this device. A constant-speed induction motor operates the "setback" mechanism, which in turn is in contact with the friction-indicating pointer. The former operates at one-half-hour intervals and at the end of this period is released and automatically returns to zero, the friction pointer remaining at its position. The setback pointer is again engaged with the advancing mechanism and travels forward as before. The friction or indication pointer will, at the

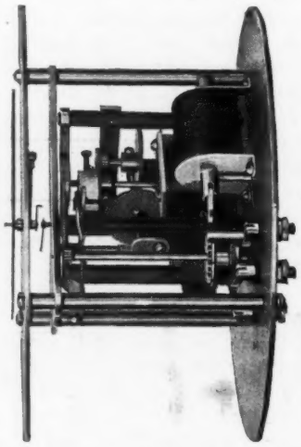


Fig. 2—Interior View of Maximum-Demand Indicator.

end of any time such as a week or a month, indicate the amount of travel of the setback pointer, which is the indication of the maximum demand. The energy consumption of the motor is approximately 7.5 watts. A special type of bearing is used which requires no oiling. It is claimed that the device will run two years without attention. It is manufactured by the Chicago Electric Meter Company, Chicago, Ill.

MOTOR-DRIVEN BLOWERS.

In the blower illustrated herewith particular attention has been paid to the protection of the vital parts of the equipment. The motor, which has been especially designed for work, is fully inclosed, thereby being protected from dust and dirt. The outlet casing is so designed that the blower may be mounted on either the floor, the ceiling or the wall, with the outlet pointed in any desired direction.

Motor-Driven Blower.

The rotor of the blower is built of aluminum and is provided with twelve cup-shaped blades. The bearings are of phosphor bronze, equipped for lubrication with grease that has a high-temperature melting point. This blower has been placed on the market by the Horning Electric Manufacturing Company, Cleveland, Ohio.

AUTOMATIC TELEPHONY IN GREAT BRITAIN.

For the past eighteen months the British Post Office authorities have been devoting much attention to the question of automatic telephony, and members of the staff visited the United States to investigate what was being done there in this branch of telephony. Subsequently, in July last year, it was announced that orders had been given for two 500-line full automatic exchanges, with which it was the intention to gain experience as to the relative cost of installation and working and reliability of two different systems under British conditions. It was decided to equip an exchange at Epsom on the Strowger system, the British rights for which have been taken over by the British Insulated & Helsby Cables, Ltd. (which have formed the Automatic Telephone Manufacturing Company, Ltd., for the purpose of developing the system in Great Britain), and another exchange at Caterham Valley on the Lorrimer system. It will be remembered that there is a good deal of difference between the two systems. In the Lorrimer exchange a power plant is necessary, for the apparatus contains parts which are continuously revolving and which are arrested in suitable positions when the call is originated, while in the Strowger system no movement takes place until the actual calling current impulses are sent. Again, in the Lorrimer system the figures composing the call are, so to speak, stored up in the calling apparatus when a button is pressed, and the complete call is signaled. In the Strowger system the subscriber sets his apparatus successively for the units, tens, hundreds, etc., sending separate impulses which actuate the step-by-step electromagnetic switches in the exchange. The Epsom Strowger exchange was opened on May 26, the Caterham Valley exchange being somewhat delayed owing to the difficulty the contractors found in delivering the necessary plant.

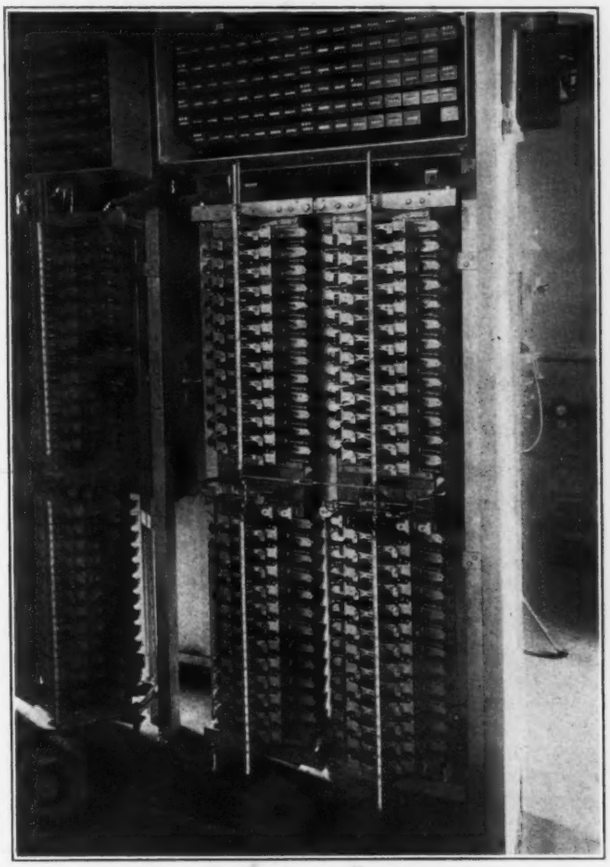


Fig. 1—Group of Line Switches.

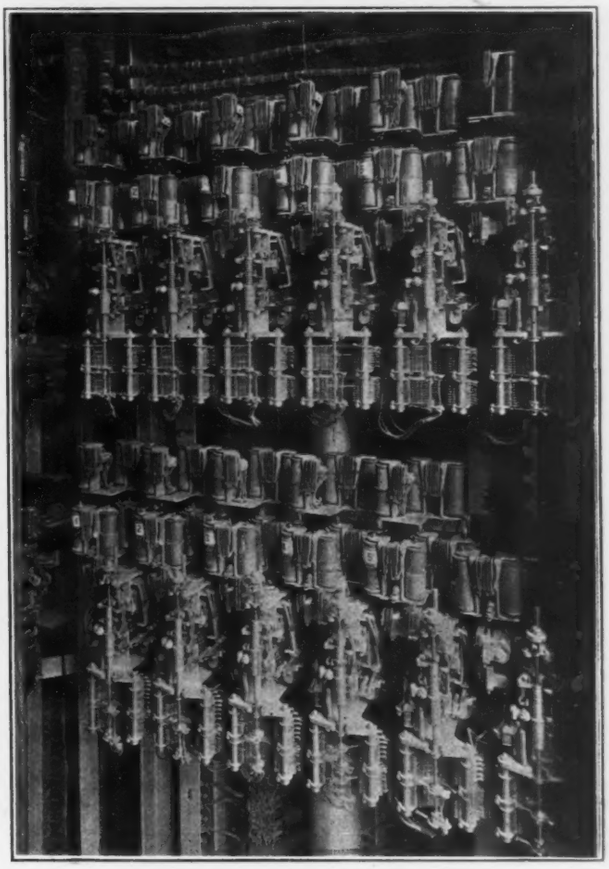


Fig. 2—Group of Connector Switches.

The Epsom exchange was selected by the Post Office for the first trial of an automatic system in Great Britain under real working conditions, owing to its being one of the smaller exchanges in the Metropolitan exchange area in which the percentage of local calls is extremely high. No less than 52 per cent of the calls are local, a very high figure compared with the 15 or 20 per cent in many of the larger exchanges in London. The exchange is equipped for 400 lines; the local operating is entirely automatic, and the junction operating is partly automatic. All the subscribers on the Epsom exchange have had three-figure numbers, from 200 upward, given to them. Each subscriber has a map on his instruction card, upon which the position of the various exchanges in the Metropolitan area is marked. This is divided in the map into three districts. If the subscriber wishes to obtain a connection to an exchange in the central or northern area, he calls up 15 and is automatically connected to a junction line to the city exchange. He then gives the number he requires to the operator there, who makes the connection in the ordinary manner. From the southeastern district he calls 16, and his call is dealt with in the same way at Croydon, and for the southwestern district he calls 17, and his call is handled at Sutton.

The working of the exchange is on the latest Strowger system. To call a number the subscriber first removes his receiver and then places his finger in the hole in the dial plate opposite the hundreds digit of the number required, turns it round to a stop and releases it, and then repeats the operation for the tens and units digits.

At the exchange each subscriber's line, after passing through the main frame (which is of standard construction) is led to a Keith line switch. A group of 100 of these switches is shown in Fig. 1. The function of this switch is to connect the line, as soon as the subscriber re-

moves his receiver, to one of the ten "trunk" lines leading to the "first selectors." By an ingenious device the line is automatically connected to the first free one of these trunk lines. These line switches, therefore, perform the functions of the line and cut-off relays, the answering jack and the answering plug of an ordinary manual exchange, and the "trunk lines" to the line selectors correspond to the operator's cords, the switch instead of the operator selecting a free one. The ten trunk lines allotted to each group of 100 subscribers lead to "wiper" contacts on the first or "hundreds" selectors through a small intermediate distributing frame. Finally there are ten "connector switches" for each of the hundreds, on which all the subscribers of that hundred are multiplied. The first selector moves the wiper contacts connected to the trunk line from the line switch up to the level of contacts corresponding to the hundred digit, and then rotates it until a free connector switch on that hundred group is found. Fig. 2 shows one of the groups of the connector switches.

If the wanted line is engaged, the final contact is not made by the connector switch, but connection is made to the busy-back contacts. If the line is free, connection is made to it and simultaneously to the ringing contacts, and a ringing contact is transmitted to the wanted subscriber's line until he takes down his receiver. If a subscriber endeavors to connect to a "dead" number or to number 0 (which he is directed to do for "inquiry" or "trunk"), connection is made automatically to the "inquiry" operator.

All the apparatus described up to this point, including the main frame and also the wire chief's desk, is contained in a comparatively small room on the ground floor of the house in which the exchange is placed. In the middle of the room are also a group of signal lamps of different colors to indicate a fault in any groups of switches. A white lamp glows if a subscriber has taken his receiver off and has not turned the dial; a green lamp if the switch fails to restore to normal after the conversation is concluded (in this case an audible signal is given also); a red lamp indicates a blown fuse, and a blue lamp is lighted if a line switch fails to act.

On the first floor is the "inquiring" and the incoming junction board, actually one small board with two operators, a senior for inquiry and a junior for the junction section. Incoming junction lines terminate in cords and plugs associated each with a lamp and a speaking key in the usual way. On a call being received, the operator puts over her listening key and notes the number required. Ten line selectors are allotted to the junction board, and the lines from these terminate in jacks on the board. The operator, on learning the number of the Epsom subscriber wanted, plugs into any one of these ten jacks which is free, puts over the selector line key which is associated with each cord in addition to the speaking key, and then calls the subscriber by means of a dial switch similar to that on the subscribers' instruments. She receives the line "clear" signal on the lamp in the usual manner when the operator at the originating exchange withdraws her plugs. The operating at this board is very simple and is satisfactorily performed by a junior.

In the basement are the batteries and the power plant. The former consists of twenty-five cells. The emf must be maintained at between 46 volts and 49 volts for satisfactory working, and instead of the customary switching in and out of end-cells or the use of a booster, a group of seven small cells is employed, which can be switched as required in opposition to the main battery. Motor-generators are used for charging the cells from the electricity supply mains. A substitute is employed for the ringing generator for the ringing currents and engaged signals which form part of the usual equipment of a manual exchange. A simple "harmonic converter" converts the direct current into alternating for ringing, and this is applied through an electromagnetic "ringing interrupter," which gives successive rings for a few seconds with intervals between. This arrangement has the advantage of saving power, as it is put in operation automatically when a ring is required and ceases as soon as the subscriber answers. Similarly a small electromagnetically worked pendulum and a buzzer furnish the "engaged" signal.

The arrangements at Epsom have been worked out very completely, and they will enable the Post Office to ascertain to which of the telephone exchanges the automatic system will be adaptable in the future. Larger exchanges are contemplated for Leeds, Brighton and Portsmouth, but their provision depends to a considerable extent on the possibility of obtaining equipments promptly from the manufacturers.

ELECTRICALLY OPERATED VENEERING MACHINE.

The apparatus described and illustrated herewith is a labor-saving device used in the woodworking industry. It consists of an automatic hydraulically operated door-veneering machine, the one illustrated being installed in the plant of the Commercial Sash, Door & Blind Company, Beaver Falls, Pa. This plant is equipped throughout with individual electric motor drive, a total of twenty-four motors being used.

The veneer is applied to the door frames, and when a sufficient number are ready they are placed in the compressor, as indicated in the illustration, which shows 110

Hydraulic Compressor in the Plant of Commercial Sash, Door & Blind Company.

1⅓-in. door frames piled in five rows. I-beams placed above and below are connected by turnbuckle clamps and tightened to hold the frame intact. The bottom part of the compressor is in the form of a truck which is rolled on car tracks to the press. When the desired pressure, usually from 1300 lb. to 1600 lb. per square inch, has been applied for about two minutes the pressure is relieved and the truck rolled away. A pneumatic safety valve is provided, which opens automatically at any predetermined value, thus preventing excessive pressure. The time required for compressing is only about two minutes, while that required by the old hand-operated method was from four to five hours. The electrical equipment of this plant was made by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

Industrial and Financial News

CONFIDENCE has become more widespread this week as a result of optimistic reports of the growing crops and of gain in the amount of new business being written by the steel companies. Unfilled orders on the books of the United States Steel Corporation on May 31, as shown in the monthly statement made public this week, represented a total of 5,750,983 tons, which is an increase of 86,098 tons over the amount on hand at the end of April. Business now on hand at the steel mills is sufficient to keep them in operation for several months to come, and the prospects for increased orders from the railroads as soon as good crops become a certainty make the outlook for the remainder of the year exceedingly favorable. Estimates by the government on the condition of spring wheat as of June 1 placed this at 95.8, the highest figure for the period in nine years. Money markets are still quiet, but with the crop financing and trade improvement looked for in the next few months higher rates are expected. Quotations June 12 were: Call, 2½@2¼ per cent; ninety days, 3 per cent.

Sedalia (Mo.) Light & Traction Reorganization.—On June 7 the property of the Sedalia Light & Traction Company, of Sedalia, Mo., was sold under foreclosure at Sedalia to representatives of the bondholders' committee, which is composed of Otto G. Bannard, Robert T. Sheldon and Herbert K. Hallett. As forecast in the *Electrical World* on May 18, the reorganization and management of the property will be effected under the direction of H. L. Doherty & Company, to whom it will be turned over for operation as soon as the floating liabilities have been liquidated and the receivers have been discharged. It is planned to incorporate a new company under the laws of Missouri with an authorized capital stock of $2,500,000, of which $500,000 will be preferred. A total of $2,500,000 of 5 per cent first-mortgage bonds will be authorized. Of these only $400,000 will be issued at this time. Holders of the $749,000 old bonds of the company will receive 50 per cent of their holdings in new bonds and 50 per cent in new preferred stock. Dividends on the preferred stock will be guaranteed by the Gas Securities Company of New York at the rate of 1 per cent the first year, 2 per cent the second year, 3 per cent the third year, 4 per cent the fourth year and 5 per cent the fifth year and thereafter. After seven years the preferred stock will be convertible into bonds of the company, provided the net earnings for the preceding twelve months are one and three-quarters times the interest upon all bonds then outstanding, plus one and three-quarters times the dividends on the preferred stock then outstanding. The entire issue of $2,000,000 of common stock is to be issued to Henry L. Doherty & Company and to be held for them by a trustee and will become the property of the Doherty company when the net earnings of the company are equal to one and three-quarters times the interest on the bonds and the dividends on the preferred stock for twelve months. If within seven years this proportion of the net earnings be not reached, the trustee is to deliver the common stock to the committee representing the bondholders.

Appalachian Power Development Nearing Completion.—Construction of the Appalachian Power Company's first two developments on the New River, Va., has been going forward rapidly under the supervision of Messrs. Viele, Blackwell & Buck, 49 Wall Street, New York, who expect to have the smaller station, which is near Ivanhoe, in operation by July 1. Three 3000-hp waterwheel units are now being installed in this station. The other station now under construction on the New River, which is to contain four of these 3000-hp units, will be ready in October. The common step-up transformer house about 3 miles from these plants is nearly finished. Transmission lines to Bluefield, Va., and to the Pocahontas Consolidated Collieries will be completed by Aug. 1, and the lines to Roanoke, where the Appalachian company is to sell energy at wholesale to the Roanoke Railway & Electric Company, will be ready in the fall. Details of the project were given in these columns Oct. 7, 1911.

Western Electric Company in Its Old Chicago Building.—About a year and a half ago the Western Electric Company sold its large buildings in Chicago, bounded by South Clinton, West Van Buren, South Jefferson and West Harrison Streets, having removed all its manufacturing operations to its extensive modern factory at Hawthorne, a western suburb of Chicago. A city office was retained in the old building, however, and the company has recently leased from the new owners a largely increased amount of space, amounting to about 80,000 sq. ft. This large proportion of the buildings will be used by the Western Electric Company for office and warehousing purposes and for the city repair shop. The electrical fraternity in Chicago and the West will be interested in the knowledge that this site, which has been an electrical center in Chicago for thirty years or more, is to continue as such.

Anderson (S. C.) Water, Light & Power Company Sold.—Announcement has been made by H. A. Orr, president of the Anderson Water, Light & Power Company, of Anderson, S. C., of sale of the company to W. S. Lee, vice-president and general manager of the Southern Power Company; C. Elmer Smith, president of the S. Morgan Smith Company, of York, Pa., and Elliott S. Stevenson, banker, of Detroit, Mich., and Toronto, Can. It is understood that the purchasers are planning to lease the Savannah River Power Company, of Anderson, S. C., which operates a plant at Greggs Shoals, and that construction of a station at Cherokee Shoals, of about 10,000 hp rated output, is under consideration.

Mountain States Telephone Company Acquisition.—After negotiations extending over several weeks, the Arizona Telephone & Telegraph Company, an independent concern operating in several towns in Arizona, has been acquired by the Mountain States Telephone & Telegraph Company, of Denver. The latter, as noted in the *Electrical World* July 29, 1911, was formed last year with a capitalization of $50,000,000, as a consolidation of the Tri-State Telephone Company, the Colorado Telephone Company and the Rocky Mountain Bell Telephone Company. It is now operating exchanges in Colorado, Wyoming, New Mexico, Montana, Arizona and Utah.

Republic Railway & Light to Serve Steel Companies.—Part of the energy which will be generated at the plant which the Republic Railway & Light Company is building at Lowellville, Ohio, to which reference was made in the last two numbers of the *Electrical World*, will be utilized by several of the iron and steel companies in the territory which it will serve. A contract has been closed with the National Malleable Iron Company, of Sharon, Pa., for a supply of several hundred horse-power, and negotiations for other contracts of this character are in progress.

Electric Bond & Share Subscriptions.—Preferred stockholders of the Electric Bond & Share Company have been notified that stockholders of record of June 6 will have the right to subscribe pro rata to 15,000 shares of preferred stock at par plus accrued dividends. Payments may be made in two instalments, one payable June 24 and the other Nov. 1, this being optional with subscribers. Common-stock holders have agreed to purchase such new stock as shall not have been subscribed for by the preferred-stock holders on or before June 24.

Consumers' Power Company (Minn.) Stock Increase.—Amendment to its articles of incorporation increasing its capital stock from $10,000,000 to $17,000,000 and moving its office from Stillwater to Minneapolis have been filed by the Consumers' Power Company. The company will extend its overhead transmission lines for about 5 miles in order to connect its stations with those of the Minneapolis General Electric Company, thus providing for an interchange of energy over the systems operated by these companies.

Southern Wisconsin Power Company Bonds.—Chicago and Philadelphia interests are offering first-mortgage 5 per cent sinking-fund gold bonds of the Southern Wisconsin Power Company, of Kilbourn, Wis. These bonds are dated Oct. 1, 1908, and are due Oct. 1, 1938, but are redeemable on any interest date upon sixty days' notice at 105 and interest. The company has $1,500,000 capital stock, with an authorized issue of $2,500,000 first-mortgage 5 per cent bonds, of which $2,025,000 are outstanding. The company, a Wisconsin corporation operating under perpetual charter, owns and operates a 6,000-kw hydroelectric plant on the Wisconsin River near Kilbourn, Wis. It has contracts for the sale of practically the entire output of this plant. The principal contract is with the Milwaukee Electric Railway & Light Company and is for a period of twenty-five years. Under the terms of this contract the Southern Wisconsin Power Company is assured a minimum yearly revenue more than sufficient to pay all operating expenses, depreciation, fixed charges and interest requirements on its entire authorized issue of first-mortgage bonds. Gross earnings in the year ended April 30, 1912, were $195,246, operating expenses and taxes were $38,859, and net earnings were $156,386. Interest on outstanding bonds was $100,208, leaving surplus earnings of $56,178.

Additions to Idaho Power & Transportation Company's Plant.—The Idaho Power & Transportation Company, which furnishes central-station service to Lincoln, Iona, Thornton, Sugar, Teton, Elva, Rexburg, St. Anthony and Rigby, Idaho, is just completing the installation of two 600-kw vertical Allis-Chalmers waterwheel units at its Snake River generating station, 2 miles below the city of Idaho Falls. The original equipment of this plant included three 225-kw waterwheel sets, developing a head of 16 ft. A. V. Scott, of Idaho Falls, is president of the company. The new additions were carried out at the expense of considerable difficult excavating in the hard lava-rock bed of the river, as the design of the original plant did not contemplate extensions. With its increased capacity the company now plans to enter upon active sales campaigns in the communities it serves.

Buffalo (N. Y.) Electric Vehicle Companies Merged.—The Buffalo Electric Vehicle Company, recently incorporated in New York State, is a merger of a number of electric vehicle and allied companies in Buffalo, N. Y. It has acquired by purchase and will consolidate the Babcock Electric Carriage Company, the Buffalo Automobile Station Company, the Buffalo Electric Carriage Company and the Clark Motor Company. Manufacture of Babcock electric pleasure cars and Van Wagoner trucks will be continued by the new company. The Buffalo automobile station will be operated solely for the convenience of the company's patrons, the service to be rendered at a nominal cost. The authorized preferred stock of the company is $300,000, of which $250,000 is issued, and the authorized common stock is $700,000, of which $600,000 is issued.

Will Redeem Bonds of Pittsburgh Reduction Company.—Announcement has been made by the Aluminum Company of America, known at one time as the Pittsburgh Reduction Company, that it will redeem on July 1, 1912, at its Pittsburgh office, the issue of $1,450,000 collateral trust 4 per cent fifty-year gold bonds of the St. Lawrence Securities Company, of Massena, N. Y., guaranteed by the Pittsburgh Reduction Company, with accrued interest to that date. The St. Lawrence Securities Company was incorporated in 1906 in New York State as a holding company to acquire the stocks of the St. Lawrence County Electric & Water Company, the St. Lawrence Water Company, the Massena Electric Light & Power Company, and the St. Lawrence River Power Company, all of its stock being secured by the Aluminum interest.

Progress of Toledo Railways & Light Reorganization.—No agreement upon a complete plan for reorganization of the Toledo Railways & Light Company was reached by the bondholders' and stockholders' committees at their meeting on June 6. To facilitate progress in arriving at a satisfactory arrangement three members of each of these two committees were appointed members of a sub-committee. This sub-committee is to report progress to the bondholders' committee by June 26. In case a plan acceptable to both classes of security holders is not formulated by the sub-committee by that time the bondholders' committee will take steps of its own to reorganize the company.

Burlington (Ia.) Railway & Light Company.—William Morris Imbrie & Company, New York, N. Y., as members of a syndicate of which the Equitable Trust Company, New York, N. Y., is manager, are offering for subscription first-mortgage 5 per cent sinking-fund gold bonds of the Burlington Railway & Light Company at 96½ and interest, to yield about 5.30 per cent. The bonds are dated March 1, 1912, and are due on March 1, 1932. They are callable at 105 and interest on any interest date on three months' notice. The total authorized issue of these bonds is $7,500,000, of which $1,400,000 is outstanding.

To Reincorporate Puget Sound Traction, Light & Power Company.—On June 27 stockholders of the Puget Sound Traction, Light & Power Company, which was incorporated early this year under Maine laws as a merger of several Stone & Webster interests on the Pacific Coast, as noted in these columns Jan. 13, will adopt a resolution authorizing the directors to reincorporate the company under Massachusetts laws. Provision for this step was made at the time of incorporation. The stock of the company will be non-taxable under the Massachuetts laws.

By-Product Coke Oven Gas for Motive Power.—A 1500-kw gas engine to operate on by-products coke-oven gas is being built by the Bethlehem Steel Company for use in its rolling mill. The gas will be furnished from a coke-oven plant which the Didier-Marsh Company is erecting at the steel works. The engine, according to the Bethlehem Steel Company, will be the largest by-product coke-oven gas-engine in the United States. The energy developed by the generator which it will drive will be used for running motors throughout the rolling mill.

United Gas & Electric Corporation Merger Ratified.—Stockholders of the Susquehanna Railway, Light & Power Company at a special meeting in Hartford, Conn., on June 6, ratified unanimously the proposition to merge the company with the United Gas & Electric Corporation of Connecticut. Announcement of this proposition and of the total capitalization and holdings of the United company upon consummation of the plan was made in these columns May 25 and June 1.

Providence (R. I.) Company Changes Hands.—Bodell & Company, of Providence, R. I., have purchased control of the stock of the Westerly Light & Power Company, of Westerly, R. I. They have placed it in a five-year voting trust. The company serves Westerly, Watch Hill, Ashaway and Pleasant View, R. I., and Pawcatuck, Stonington, Mystic and a portion of Groton, Conn. Extensions of the service will be made by the purchasers.

Financing Cleveland Municipal Plant.—Judge Collister, at Cleveland, in a decision in the taxpayers' action brought to restrain the sale of the $2,000,000 municipal lighting plant bonds, has ruled that the City Council must pass a new ordinance authorizing the sale of the bonds and that these bonds may be advertised and sold sixty days after the passage of the ordinance.

Further Opposition to Allis-Chalmers Foreclosure.—Nathan Eisemann, of Boston, owner of $50,000 bonds and 800 shares of the preferred stock of the Allis-Chalmers Company, has filed a petition in Milwaukee in the foreclosure proceedings brought against the Allis-Chalmers Company, to which reference was made in the preceding issue of the *Electrical World*.

Opposition to Hamilton Gas & Electric Sale.—Edward Foy, a creditor and bondholder of the Hamilton Gas & Electric Company, of Hamilton, Ohio, has protested against the sale of the properties of the company and those of the Hamilton Otto Coke Company, under foreclosure on July 8. Notice of this sale was given in these columns.

Initial Dividend of New Orleans Railway & Light Company.—Directors of the New Orleans Railway & Light Company have declared an initial dividend of 1 per cent on the $20,000,000 common stock of the company, payable July 1 to holders of record June 14.

Earnings of Marconi Wireless Telegraph Company, Ltd.—The net profits of the Marconi Wireless Telegraph Company, Ltd., of London, in 1911, were $708,585 as compared with $307,565 in 1910.

Home Telephone & Telegraph (Los Angeles) Bond Offering.—Los Angeles and San Francisco financial houses are offering at 82½ and interest, yielding about 6¼ per cent, first and refunding mortgage forty-year 5 per cent sinking-fund gold bonds of the Home Telephone & Telegraph Company, of Los Angeles, Cal. These bonds are dated 1905 and due July 1, 1945, but are callable on and after July 1, 1920, at 105 and interest. The authorized stock issue of the company is $6,000,000, of which $3,000,000 is preferred. There is an authorized issue of $2,500,000 first-mortgage bonds, of which $2,231,000 are outstanding, and an authorized issue of $5,000,000 first and refunding mortgage bonds, of which $2,301,000 are outstanding. The company serves Los Angeles and the contiguous territory, including Hollywood, Huntington Park and South Pasadena. Its gross earnings in 1911 were $1,293,355 and the balance applicable to dividends, sinking fund and depreciation was $312,119, as compared with $301,929 in 1910. A. B. Cass is president of the company, W. C. Patterson is vice-president, E. P. Morphy is secretary, and M. H. Hellman is treasurer.

To Merge Evansville (Ill.) Utilities.—Following the recent merger of the Evansville Public Service Company and the Evansville & Southern Indiana Traction Company, of Evansville, Ill., it is learned that these companies are to be merged with the Evansville Gas & Electric Company into a new concern which will be known as the Public Utilities Company of Evansville. This new company will have an authorized issue of $10,000,000 first and refunding bonds, $3,000,000 preferred stock and $3,000,000 common stock. All of the common stock has been acquired by Hodenpyl, Hardy & Company, of New York, who will operate the property. Of the new securities $5,000,000 bonds and $2,000,000 preferred stock will be used to purchase the underlying companies and provide for retirement of bonds.

REPORTS OF EARNINGS.

FEDERAL SIGN SYSTEM (ELECTRIC).

The income account of the Federal Sign System (Electric) for the year ended March 23, 1912, compares with that for the preceding year as follows:

	1912.	1911.
Gross earnings	$1,286,716	$663,099
Expenses, including depreciation	1,106,152	557,835
Net earnings	$180,564	$105,264
Reserves	39,696	12,754
Balance	$140,868	$92,510
Preferred dividends	77,929	30,775
Surplus	$62,939	$61,735
Total profit and loss surplus	$146,648	$83,709

MEXICAN LIGHT & POWER COMPANY, LTD.

The income account of the Mexican Light & Power Company, Ltd., for the fiscal year ended Dec. 31, 1911, compares with that for the preceding year as follows:

	1911.	Increase.
Profits	$2,677,412	$117,262
Interest, sinking fund and other charges	1,425,732	159,189
Balance for dividends	$1,251,680	*$41,927
Preferred dividend	420,000	103,250
Balance for common	$831,680	*$145,177
Common dividend	543,400	.....
Surplus	$288,280	*$145,177
Previous surplus	745,848	433,457
Total surplus	$1,034,128	$288,280

*Decrease.

The balance sheet as of Dec. 31, 1911, shows total assets and liabilities of $48,377,980, as compared with $44,231,926 in the preceding year. Cash on hand was $406,502, as compared with $1,082,194. The report states that increase in the sale of energy for motor service was very satisfactory during the year and that there is every indication that the mining companies in the Pachuca district will speedily increase their electrical equipment. To unite more closely the management of the light and power company and that of the Mexican Tramways Company, Harro Harrison, general manager of the Tramways company, was also appointed general manager of the first-named company.

FEDERAL LIGHT & TRACTION COMPANY.

After elimination of inter-company earnings the comparative consolidated statement of earnings and expenses of the subsidiaries of the Federal Light & Traction Company, 60 Broadway, New York, for the months of April, 1912 and 1911, and for the twelve months ended on those dates shows as follows:

	April, 1912.	April, 1911.	Increase.
Gross	$113,059	$98,102	15.22
Operating expenses	64,937	56,828	7.02
Net	$48,122	$41,273	16.56
Twelve months ended April 30.			
	1912.	1911.	
Gross	$1,319,390	$1,206,639	9.37
Operating expenses	757,959	679,203	11.61
Net	$561,431	$527,435	6.43

Earnings of the Trinidad (Col.) Electric Transmission, Railway & Gas Company and the Deming (N. M.) Ice & Electric Company are not included in either of the above tables. Net earnings of the Trinidad company in April were $6,978 and in the twelve months ended April 30 were $69,026.

MAY STATEMENT OF COPPER PRODUCERS' ASSOCIATION

The May statement of the Copper Producers' Association, issued June 8, compares with the April statement as follows:

	May, Pounds.		April, Pounds.	
Stocks on hand in the United States on first of month		65,066,029		62,367,557
Production		126,737,836		125,464,644
		191,803,865		187,832,201
Domestic deliveries	72,702,277		69,513,846	
Export deliveries	69,485,945		53,252,326	
Total deliveries		142,188,222		122,766,172
Stocks on hand at the end of the month		49,615,643		65,066,029

PRICES IN THE NEW YORK METAL MARKET.

Copper:	June 4 Bid.	June 4 Asked.	June 11 Bid.	June 11 Asked.
Standard:				
Spot	16.50	17.00	16.70	17.25
June	16.50	17.00	16.75	17.25
July	16.50	17.12½	16.75	17.25
August	16.50	17.12½	16.80	17.25
September	16.50	17.12½	16.80	17.37½
London quotation:	£ s d		£ s d	
Standard copper, spot	77 2 6		77 18 9	
Standard copper, futures	77 13 9		78 11 3	
Prime Lake	17.12½		17.50	
Electrolytic	17.00		17.25	
Casting	16.70		17.12½	
Copper wire, base	17.75		18.25	
Lead	4.20		4.20	
Sheet zinc, f.o.b., smelter	8.65		8.65	
Spelter, spot	7.00		7.00	
Nickel	39.00 to 40.00		39.00 to 40.00	
Aluminum:				
No. 1 pure ingot	21@22		21@22	
Rods and wire, base	31		31	
Sheets, base	33		33	
OLD METALS.				
Heavy copper and wire	16.00		16.50	
Brass, heavy	10.25		10.25	
Brass, light	8.50		8.50	
Lead, heavy	4.05		4.05	
Zinc, scrap	5.75		5.75	

COPPER EXPORTS IN JUNE

Total tons, including June 5..... 3,799 June 11..... 8,895

STOCK MARKET PRICES

	June 5.	June 12.
Allis-Chalmers	⅞*	¾
Allis-Chalmers, pf.	2¾*	2½*
Amalgamated Copper	85⅞	85¾
Amer. Tel. & Tel.	145⅞	145⅞
Boston Edison	283 *	285 *
Commonwealth Edison	138¼	138¼*
Electric Storage Battery	55¼	56
General Electric	170½	169
Mackay Companies	87⅝	87⅝*
Mackay Companies, pf.	69⅞	68⅝*
Philadelphia Electric	21¼	22¼
Western Union	83	83½
Westinghouse	74	72½
Westinghouse, pf.	117	117 *

*Last price quoted.

Personal

Mr. Charles A. Harmony, municipal electrician at Centralia, Wash., has been appointed district superintendent for the Washington-Oregon Corporation.

Mr. A. A. Dobson, Justice of the Manitoba Court of the King's Bench, has been appointed a public utilities commissioner for the Province of Manitoba.

Mr. Nicholas Biddle has been elected a director of the Niagara Falls Power Company, to fill the vacancy caused by the death of Mr. John Jacob Astor.

Mr. Lester McKenney, formerly electrical engineer of the Garver Print Works & Bleachery, Wappingers Falls, N. Y., has accepted a similar position in the Boston office of Mr. C. H. Fish, consulting engineer.

Mr. Henry W. Eels, who has been superintendent of the Portland (Maine) Electric Company, has resigned to become general superintendent of the Central Maine Power Company, with headquarters at Augusta.

Mr. Charles A. Barker, recently with the Westinghouse Electric & Manufacturing Company at Atlanta and New York, has been elected president of the Suburban Equipment Company, with headquarters in New York City.

Prof. Albert F. Ganz, of the department of electrical engineering, Stevens Institute of Technology, delivered a lecture on "Electrolysis from Stray Electric Currents" before the American Water Works Association at Louisville, Ky., on June 6.

Mr. Phillips Thomas, who has been connected with Princeton University as a J. W. Queen scholar in physics, has accepted a position in the research division of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

Mr. Marius Latour, inventor of the alternating-current commutating motor with which his name is associated, is the author of a book entitled "Premiers Principes d'une Théorie Générale des Emotions," which is being translated into English by Mr. C. O. Mailloux.

Mr. Louis A. Ferguson, of Chicago, vice-president of the Commonwealth Edison Company, who has endured a painful illness as the result of a large carbuncle, is making an excellent recovery, although it will be several weeks, probably, before he will be able to resume his office duties.

Mr. Edward B. Pollister, formerly manager of the Robinson (Ill.) Water, Light & Heat Company, a property recently sold to Messrs. Henry C. Starr, of Chicago, and J. P. Goodrich, of Indianapolis, has accepted a position with the Busch-Sulzer Brothers-Diesel Engine Company, of St. Louis, Mo.

Mr. L. G. White has resigned as general superintendent of the Columbus Railway & Light Company, Columbus, Ohio, in order to accept a position with the Public Service Commission of Ohio. Mr. White has been connected with the electric lighting and railway interests in the city of Columbus, Ohio, for the past twenty years.

Mr. Clifford S. MacCalla, general manager of the Washington Water Power Company, Spokane, Wash., who has recently been seriously ill, is now convalescing rapidly. His physicians advised a rest until fall, and Mr. MacCalla and his family left Vancouver, June 12, on the steamer *Makura* for a trip to Sydney, Australia.

Mr. C. D. Warner, formerly assistant chief engineer of the Moore Light Company, has recently become associated with the Marconi Wireless Telegraph Company of America, with headquarters in New York. Mr. Warner is giving considerable attention to the design and equipment of the three stations which the company is installing for the United Fruit Company.

Mr. E. C. Ferguson addressed the Electric Club of Chicago on June 6 on "The Co-ordinating of the Interests of a Big City." Mr. Ferguson is a lawyer and chairman of the Chicago Association of Commerce committee on relations with the societies and clubs in Illinois outside of Chicago. His relations with local electrical interests were somewhat intimate in previous years, and he was a charter member of the Chicago Electric Club, which flourished twenty years ago, but ceased to exist after the World's Fair of 1893.

Prof. Frank W. Springer, of the department of electrical engineering of the University of Minnesota, is the author of a series of articles in the *Minnesota Alumni Weekly* entitled "Phases of Life and Education in America, France and Germany, and the Spherical-Want System of Teaching." Prof. Springer spent his sabbatical year, beginning June 11, 1910, in studying the methods of instruction in France and Germany.

Mr. William A. Scott has become associated with the Crocker-Wheeler Company as resident salesman in Springfield, Mass. Mr. Scott entered the testing department of the General Electric Company, Schenectady, in 1899. He later accepted a position with the Ward-Leonard Electric Company, and was subsequently for five years in the testing and sales departments of the Stanley Electric & Manufacturing Company. In 1906 he entered the employ of the Edison Electric Illuminating Company of Boston, and later was associated with the Boston office of the Westinghouse Electric & Manufacturing Company.

Mr. Charles E. Lord has resigned his position as patent attorney for the Bullock Electric Manufacturing Company and the Allis-Chalmers Company, with which he has been associated for the past eight years, to become patent attorney in charge of all the patent work of the International Harvester Company, with headquarters in the Harvest Building, Chicago. Mr. Lord, who is a graduate from the electric engineering course at the Massachusetts Institute of Technology, has had granted to him or has pending about forty patents relating mainly to electrical inventions. He has acted as associate editor of several textbooks on engineering subjects. He was for several years examiner in the United States Patent Office. He studied law and was admitted to the bar in Ohio. Subsequently he became a member of the bar of the Supreme Court of the United States. He was employed for a time in the patent department of the General Electric Company. Mr. Lord is a member of the American Institute of Electrical Engineers, of the American Society of Mechanical Engineers and of the American Electrochemical Society.

Mr. Harry B. Ivers, general manager and purchasing agent of the Lewiston, Augusta & Waterville Street Railway, of Lewiston, Me., has been appointed general manager of the Cumberland County Power & Light Company, of Portland, Me., in which capacities he will divide his time between these cities. Mr. Ivers' connection with public service companies dates from 1893, when he became associated with the Hyde Park (Mass.) Electric Light Company. He was connected with that company for several years, during which the formation and construction of the Norfolk Street Railway, the West Roxbury & Rosindale Street Railway and the Norfolk Central Railway were effected. All of these companies were later acquired by the Massachusetts Electric Companies, Mr. Ivers assisting in consolidating the accounts and in operating the lines. He was connected for nine years with the Old Colony Street Railway Company. After this he was successively treasurer and manager of the Westerly (R. I.) Railway & Lighting Company and the Bangor (Maine) Railway & Electric Company, and treasurer of the Bar Harbor (Maine) & Union River Power Company. Subsequently he was appointed general manager of the Lewiston, Augusta & Waterville Street Railway, Maine.

Obituary

Mr. William R. Beal, president of the Central Hudson Gas & Electric Company, Poughkeepsie, N. Y., died on June 5 at his home in Newburgh, N. Y. Mr. Beal was active in the welfare work in his community. He built a Young Men's Christian Association building in the Bronx, New York City, which section he helped to develop, and last year he gave a twenty-thousand-dollar site to the Newburgh Young Men's Christian Association. He was for years the president of the American Gas Association, served as trustee of Rutgers College, and was once chairman of the Board of School Trustees of New York. Mr. Beal was seventy-four years old. He leaves a widow, four sons and two daughters.

Construction

ATHENS, ALA.—At an election held June 7 the proposition to issue $12,000 in bonds for machinery for light and water plant was carried.

BESSEMER, ALA.—The Birmingham Ry., Lt. & Pwr. Co. is planning to extend its lighting system to Lipscomb, 2 miles distant. The installation of a street-lighting system is also under consideration by the citizens of Lipscomb.

MOBILE, ALA.—The stockholders of the Mobile West Shore Trac. Co. have authorized a $2,000,000 bond issue for the construction of its proposed electric railway, which will extend along the western shore of Mobile Bay, touching the coast resorts of Mobile County and extending along the Mississippi Sound as far as Pascagoula, Miss. The company will furnish electricity for lighting. Hurisco Austell, Mobile, is president; Robert K. Warren, 53 St. Michael Street, Mobile, vice-president and general manager.

LITTLE ROCK, ARK.—The City Council has granted the Arkansas Cold Storage Co. a franchise to construct and operate an electric light and power plant for a term of 30 years.

ALAMEDA, CAL.—Plans are being prepared by Joseph B. Kahn, superintendent of the municipal electrical department, for the erection of a new power house on the estuary near the north end of Grand Street, at a cost of about $25,000. The equipment will include the installation of a new 650-hp engine and a 1200-kw steam turbine generator, which will double the present output of the plant, at a cost of $110,000. This estimate covers the cost of the new unit, together with auxiliaries, boilers, heaters, pumps, foundations, etc. The machinery of the present plant will be installed in the new building. Improvements will be made to the distributing system. Bonds to the amount of $150,000 were recently authorized for this work.

ALTADENA, CAL.—The Board of Supervisors has granted the Pacific El. Ry. Co. a franchise to construct an electric railway on Mendocino Street, between Lake Avenue and Allen Avenue.

BLOOMINGTON, CAL.—The Crescent City Ry. Co. is planning to extend its railway from Bloomington to Rialto, a distance of about 8 miles.

FRESNO, CAL.—The San Joaquin Lt. & Pwr. Co. is extending its transmission lines into the country districts in Merced and Madera Counties to supply electricity for pumping water for irrigaton purposes.

GLENDALE, CAL.—The Glendale & Verdugo Mountain Ry. Co. will soon begin work on the construction of an electric railway, 2 miles long, to connect Glendale and Los Angeles with the summit of Verdugo Mountain. Lewis T. Ginger, Glendale, is president.

GRASS VALLEY, CAL.—The Rio Antigua Mining Co., Los Angeles, has taken over the entire South Fork properties at Forest City. An electric plant will be installed to supply electricity for lamps and motors for the company, which has been operating properties for the past seven years.

LOMPOC, CAL.—The Lompoc Lt. & Pwr. Co. has applied to the State Railroad Commission for permission to issue $75,000 in bonds.

LOS ANGELES, CAL.—The Pacific Lt. & Pwr. Co. is planning to furnish electrical service to residents of North Highland Park.

OAKLAND, CAL.—The City Council has awarded the contract for lighting the streets of the city and public buildings to the Pacific Gas & El. Co. for one year, which will involve an expenditure of about $140,000.

ORANGE, CAL.—The Pacific Tel. & Teleg. Co. has been granted a 45-year franchise to erect and operate telephone lines over the public highways in Orange.

PALO ALTO, CAL.—At an election held recently the citizens voted to issue $20,000 in bonds for a municipal electric-light plant and $12,500 for machinery.

PASADENA, CAL.—The Pacific El. Ry. Co. has applied to the City Council for a 30-year franchise to construct and operate an electric railway on Lincoln Avenue.

PORTERVILLE, CAL.—The Mount Whitney Lt. & El. Co., Visalia, has applied for a franchise to supply electricity for lamps and motors here.

RIALTO, CAL.—The citizens of Rialto have voted to raise $25,000 to secure the Pacific Electric railway right-of-way for an electric railway between San Bernardino and Ontario, a distance of about 20 miles.

SAN BERNARDINO, CAL.—The Pacific El. Ry. Co. has been granted permission by the City Council to double-track its line on Rialto Avenue.

SAN DIEGO, CAL.—The San Diego, Riverside & Los Angeles Ry. Co. will soon begin work on the construction of a new electric railway to connect San Diego and Los Angeles. G. W. Pursell is engineer.

SAN FRANCISCO, CAL.—The Pacific Gas & El. Co. has applied to the State Railroad Commission for permission to construct a transmission line from its proposed power plant on the Bear River in Placer County, across the Sacramento Valley, to a point on Carquinez Straits, opposite the town of Crockett.

SAN FRANCISCO, CAL.—The Board of Public Works has awarded the contract for supplying electrical energy for operating the Geary Street railway to the Pacific Gas & El. Co. at 1 cent per kw-hr. for direct current. The money that was to have been spent for power house and substation will be expended for extensions to the line.

SAN FRANCISCO, CAL.—The Board of Harbor Commissioners has directed Secretary Merle to notify the Pacific Gas & El. Co., the Pacific Tel. & Teleg. Co. and all electric light and telephone companies to remove all poles and overhead wires on East Street from the Ferry Building north to Lombard Street. All wires must be placed in underground conduits before Jan. 1, 1913.

SAN LUIS OBISPO, CAL.—Sealed bids will be received by the Board of Supervisors until July 2 for the sale of a franchise applied for in the county of San Luis Obispo to construct and operate electric transmission lines over certain highways in the county for a period of 50 years.

VALLEJO, CAL.—The County Supervisors have sold a franchise allowing the Great Western Pwr. Co. to operate in Solano County, for which the company paid $185.

WEED, CAL.—The California-Oregon Pwr. Co. is contemplating extending its transmission lines from the Albee substation, near Weed, to the ranches in the Edgewood country between the forks of the Big Springs and the Slough Road, near the Albie ranch, to supply electricity for lamps and motors. The company, it is said, is negotiating for the electric plant in Edgewood, owned by R. E. Cavanaugh. C. E. Norman is local manager.

WILLOWS, CAL.—Right-of-way is being secured by the Sacramento Valley West Side El. Ry. Co. for its proposed electric railway to connect Red Bluff, Sacramento and San Francisco, and intervening towns, a distance of 160 miles. Work will soon begin on construction of the road. Charles L. Donohue, Willows, is president, and Melville Dozier, Jr., Sacramento, chief engineer.

WATERBURY, CONN.—The Board of Aldermen has authorized the Mayor to enter into a 10-year contract with the United El. Lt. & Wtr. Co. for 24 colonial standard five-lamp electroliers, to be erected on the Green, at $58 each per year, and eight standard lamps and five one-lamp electroliers in Stanley Park and Union Square, at $32 each per year.

WASHINGTON, D. C.—An American forwarding firm states that one of its correspondents has written that it is interested in electrical moving signs. For further information address No. 8914, Bureau of Manufactures, Department of Commerce and Labor, Washington, D. C.

WASHINGTON, D. C.—An American consul in a Latin-American country has forwarded a report on a proposed concession for new electric car lines in his district. For further information address No. 8920, Bureau of Manufactures, Department of Commerce and Labor, Washington, D. C.

WASHINGTON, D. C.—The American consul at Montevideo, Uruguay, reports that tenders will be received until July 13 for furnishing and erecting 24 electric transporters. For further information address No. 8927, Bureau of Manufactures, Department of Commerce and Labor, Washington, D. C.

WASHINGTON, D. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until July 9 for conduit, fittings, etc., to be delivered at the various navy yards, as follows: Schedule 4646—miscellaneous steel conduit, brass conduit, steel and iron conduit fittings, brass conduit fittings. Brooklyn, N. Y., Schedule 4646—250 brass goosenecks, miscellaneous insulator hangers, 4500 porcelain clamp insulators. Application for proposals should designate the schedule desired by number. T. J. Cowie is paymaster-general.

HASTINGS, FLA.—The City Council has granted a franchise for an electric-light plant, with a proviso that the plant can be purchased by the city at the end of ten years. The franchise also provides for a contract for street lighting.

ST. PETERSBURG, FLA.—The St. Petersburg Ry. & Lt. Co. will soon begin work on its proposed extension on Central Avenue out toward Boca Ceiga Bay.

CARTERSVILLE, GA.—The city has voted to issue $50,000 in bonds for extensions and improvements to the municipal electric-light plant.

DALTON, GA.—The Eastern Tennessee Pwr. Co., Parksville, Tenn., has applied to the City Council for a franchise to supply electricity in Dalton.

MACON, GA.—The City Council has granted the Georgia Pub. Ser. Corpn. a franchise to supply electricity for lamps and motors in Macon.

PEARL HARBOR, HAWAII.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until July 6 for four electric and 18 hand-operated traveling cranes for the naval station at Pearl Harbor, Hawaii. Plans and specifications may be obtained on application to the above bureau or to the commandant of the naval station named. H. R. Stanford is chief of bureau.

ALEDO, ILL.—The local electric-light plant is reported to have been purchased by Charles A. Munroe, vice-president of the Public Service Company of Northern Illinois.

ALTON, ILL.—The City Council has granted the Piasa Pwr. & Lt. Co. a 30-year franchise to construct and operate an electric-light plant in Alton and has also awarded the company a contract for lighting the city for a period of 20 years.

BRADFORD, ILL.—The property of the Bradford El. Lt. Co., has been purchased by E. B. Hillman, of Quincy. Electricity for operating the local system will be transmitted from Wyoming, where Mr. Hillman has recently secured a 30-year franchise.

CANTON, ILL.—The Illinois Central El. Ry. Co. will soon begin work on the construction of the extension of its electric railway from St. David to Lewiston.

CHICAGO, ILL.—The Chicago Western Elevated R. R. Co., of Chicago, has changed its name to the Anglo-American Lt. & Pwr. Co.

CHICAGO, ILL.—The Chicago & Suburban Trac. Co. is planning to build an electric belt line to connect Evanston, Elgin and Oak Forest Infirmary and to extend eastward to a point near Hammond, Ind. The company expects to operate 92 miles out of Chicago. W. J. C. Kenyon is president and James O. Small secretary.

DONNELSON, ILL.—W. A. Black, president of the Village Board, and other officials have submitted a proposition to the Hillsboro El. Lt. & Pwr. Co., Hillsboro, asking it to erect a transmission line to this village to supply electricity for lighting the streets of the village and for commercial purposes.

EUREKA, ILL.—The City Council is considering among other plans for a water supply one which will require the installation of an electric motor to operate pump and electrical connections, involving an expenditure of about $1,000.

FREEPORT, ILL.—The Illinois Northern Utilities Co. is planning to erect a transmission line along the Sterling, Dixon & Eastern Railroad from Dixon to Sterling and from there to Morrison, Fulton, Tampico and Erie. The company will also supply electricity to the residences along the line.

HARRISBURG, ILL.—The Southern Illinois Ry. & Pwr. Co. is seeking a franchise to operate an electric railway through certain streets in this city.

HOPEDALE, ILL.—At an election held recently the proposition to issue $3,200 in bonds to install an electric-lighting system was carried. The service will be supplied by the Illinois Trac. System.

MOKENA, ILL.—The Village Board has granted the Public Service Co. of Northern Illinois a franchise to operate in Mokena. A contract has also been awarded for street lighting.

MORTON, ILL.—The Morton Lt., Ht. & Wtr. Co. has been awarded the contract for street-lighting for a period of three years.

QUINCY, ILL.—The City Council has adopted an ordinance requiring all overhead wires in the central part of the city to be placed underground before June, 1913.

SPRINGFIELD, ILL.—The Business Men's Association of Monroe Street is contemplating the installation of an ornamental street-lighting system. R. W. Haas is chairman of the lighting committee.

EVANSVILLE, IND.—Preparations are being made by A. C. Stone and others for the construction of an electric railway from Evansville to Indianapolis.

EVANSVILLE, IND.—Arrangements are being made by the Evansville, Chrisney & Eastern Ry. Co. to award contracts for the construction of the section from Booneville to Chrisney, via Evansville.

BURLINGTON, IA.—Extensive improvements are contemplated by the People's Gas & El. Co., which will involve an expenditure of about $200,000 and include extensions to the street-car lines, double-tracking and other improvements. C. H. Welsh is general manager.

CLEAR LAKE, IA.—The Clear Lake Independent Tel. Co. has purchased the Oakwood and Bayside telephone line and will erect an extension to Dodge's Point.

DES MOINES, IA.—Preparations are being made by the Des Moines City Ry. Co. for improvements and extension to its system, including several extensions to its lines, double-tracking, purchase of new cars, etc., to cost about $257,795. J. R. Harrigan is vice-president and general manager.

DOWS, IA.—The Segar Engine Works, which were recently granted a franchise to construct and operate an electric-light plant here, will expend from $10,000 to $12,000 on the plant. A movement has been started to install an ornamental street-lighting system on the principal business streets.

DUBUQUE, IA.—The City Council has granted the Union El. Co. a 25-year franchise for an extension of the street-car line from Rhomberg Avenue on Seventh Street into Eagle Park.

GLIDDEN, IA.—The local electric-light plant has been purchased by Samuel C. Johnston, of Leon.

LENOX, IA.—The Lenox El. Lt. & Pwr. Co. has filed amendments to its charter changing its name to the Lenox El. Co. and increasing its capital stock to $10,000.

LEON, IA.—A movement has been inaugurated for the installation of cluster lamps in Leon.

ONAWA, IA.—Steps have been taken by the Commercial Club to secure the installation of a new street-lighting system in the business district.

RICEVILLE, IA.—The capital stock of the Farmers' Tel. Co. has been increased from $9,000 to $25,000. The company proposes to take over the Riceville exchange and connecting lines of the LeRoy company.

SLOAN, IA.—George C. O'Donaghey, representative of the Alamo Engine & Supply Co., Omaha, Neb., has submitted a proposition to the City Council relative to the installation of an electric-light plant and water-works system.

WHAT CHEER, IA.—The property of the What Cheer El. Lt. Co. has been purchased by F. A. Heilman. The new owner will make improvements to the plant, including the installation of new machinery. T. W. Richardson will be president of the new company and Mr. Heilman secretary.

AXTELL, KAN.—At a special election held June 3 the proposition to issue $10,000 in bonds for the installation of an electric-light system was carried. It is proposed to purchase electricity to operate the system.

LAWRENCE, KAN.—A petition signed by the business men has been presented to the City Council asking for the installation of an ornamental street-lighting system in the business district.

NEWTON, KAN.—The city commissioners have signed a contract with the Kansas Gas & El. Co. for the installation of a complete street-lighting system. The contract calls for 18 arc lamps and 100 tungsten lamps.

TOPEKA, KAN.—Improvements will be made to the municipal electric-light plant, at a cost of $3,500, to enable the plant to furnish current for the new ornamental street-lighting system on East Fourth Street.

WAMEGO, KAN.—The City Council has awarded a contract to the Westinghouse El. & Mfg. Co. for one 150-kw, three-phase, 60-cycle, 2300-volt generator with exciter and switchboard panel to be installed in the municipal electric-light plant. This installation will increase the output of the plant to 240 kw. D. A. Course is superintendent of the water and light plant.

BURKESVILLE, KY.—The installation of an electric-light plant is under consideration by C. R. Payne. The plant will be driven by an oil engine.

LOUISVILLE, KY.—Negotiations have been closed whereby H. M. Byllesby & Co., of Chicago, Ill., have acquired the property of the Kentucky El. Co., Louisville.

LOUISVILLE, KY.—The Middle West Utilities Co., recently organized, is reported to have taken over the control of the Louisville & Northern Ry. & Ltg. Co., the Louisville & Southern Indiana Trac. Co., the United Gas & El. Co. of Southern Indiana and the New Albany Wtr. Co., of New Albany, Ind. It is proposed to make extensive extensions to the traction lines and arrangements are being made for a through route between Louisville and Cincinnati. The Middle West company is capitalized at $4,000,000. Samuel Insull, Chicago, Ill., and associates are interested in the project.

NEWPORT, KY.—The Board of City Commissioners has adopted a resolution authorizing Mayor Helmbold to appoint a committee to investigate various lighting plants and submit a report to the board.

FRANKLIN, LA.—The Council is contemplating extending the municipal electric-light system.

GRETNA, LA.—Leo A. Marrero purchased the franchise for the construction of an electric railway from Gretna to Waggaman for $100. The franchise is for a period of 99 years.

JENA, LA.—A franchise has been granted to Harry W. Wright, of Winnfield, to construct and operate an electric-light plant and water-works system in Jena.

BALTIMORE, MD.—The Consol. Gas, El. Lt. & Pwr. Co., has leased the properties of the Mount Washington El. Lt. & Pwr. Co., Mount Washington, and the Baltimore County Wtr. & El. Co. and will operate same. Thomas W. Offutt continues as president and general manager of the Mount Washington company and in addition will have charge of the suburban district of the Consolidated company.

BRUNSWICK, MD.—The question of establishing a municipal electric-light plant is under consideration. An appropriation of $20,000 has been made for an electric-light system.

CONOWINGO, MD.—Arrangements are being made by the Susquehanna Pwr. Co. for the construction of a dam across the Susquehanna River in connection with a hydroelectric development and electric transmission system. The proposed dam will be located about 10 miles below the large dam of the Pennsylvania Wtr. & Pwr. Co. at McCall's Ferry. This project will involve an expenditure of about $10,000,000.

FRIENDSVILLE, MD.—The Youghiogheny Pwr. Co. of Maryland, which is planning to build a hydroelectric power plant and dam across the Youghiogheny River at Friendsville, contemplates extending its transmission lines to Pittsburgh. The cost of the proposed extension is estimated at $4,000,000.

FOXBORO, MASS.—The Foxboro El. Co. has been granted permission by the Gas and Electric Light Commissioners to issue $145,000 in capital stock, of which the proceeds of $93,800 are to be paid for the property and franchise of the United El. Lt. Co., of Franklin, and the balance for improvements already made and contemplated.

SPRINGFIELD, MASS.—Bids are being asked by the Municipal Building Commission for lighting fixtures for the auditorium tower and terrace of the new municipal group. Designs and sketches to be ready for inspection not later than July 1, 1912. For further information apply to the clerk of works, Pynchon Street, Springfield. George Dwight Pratt is chairman.

WESTBORO, MASS.—The installation of a new light, heat and power plant at the Massachusetts State Hospital, to cost approximately $50,000, is under consideration.

WESTFIELD, MASS.—The Amherst Pwr. Co., of Turner's Falls, has submitted a proposition to the municipal light commission to supply electricity to operate the municipal electric system. The proposition involves abandoning the municipal electric generating plant and purchasing electricity from the power company.

ADRIAN, MICH.—Steps have been taken to organize a company to acquire franchises and operate electric light plants in towns in Lenawee, Monroe and Washtenaw Counties. The company will be known as the Southern Michigan Utilities Co.

HARTFORD, MICH.—Anderson Brothers, owners of the local electric-light plant, have placed a contract with the Westinghouse El. & Mfg. Co. for new machinery for its plant. Arrangements are being made to establish a day service.

OSCODA, MICH.—The towns of Oscoda and Au Sable have entered into a tentative contract with the Michigan Pwr. Co. under which the company is to supply electricity for lamps and motors in these places.

PINCONNING, MICH.—A special election will be held June 24 to submit to vote the proposition to grant Christopher H. Arnold a 30-year franchise to operate an electric-light plant here.

HOPKINS, MINN.—Plans are being considered for establishing an electric-light system in Hopkins. The service will be supplied by the Minneapolis General El. Co., Minneapolis.

LONG PRAIRIE, MINN.—Bonds to the amount of $9,000 have been voted for improvements to the municipal electric-light plant and waterworks system. Contract for engine and generator has been awarded to the Electrical Machine Co.

NORTH ST. PAUL, MINN.—The Village Council has engaged the Oscar Claussen Engineering Co. to prepare plans for the installation of a new power plant. The present municipal plant is unable to meet the demands made upon it.

SILVER LAKE, MINN.—The McLeod County Tel. Co. is planning to install a new telephone system here.

VERNDALE, MINN.—Application has been made for an electric-light franchise in Verndale by M. D. Stoner, who has charge of the construction work of the Crow Wing dam near Pillager.

JOPLIN, MO.—The City Council has instructed the light committee to make investigations in regard to removing the present street arc lamps and substituting cluster lamps.

ST. LOUIS, MO.—The erection of a large substation at Page Boulevard and Wabash tracks is under consideration by the Mississippi River Pwr. Distributing Co., which will distribute electricity generated at the power plant of the Mississippi River Pwr. Co. on the Mississippi River at Keokuk, Ia. The principal buildings to be erected will be 200 ft. x 60 ft. and 140 ft. x 60 ft. C. S. Ruffner is manager of the distributing company.

GREAT FALLS, MONT.—Surveys have been completed for the proposed transmission line from Great Falls to Havre. The line will supply electricity in Fort Benton, Big Sandy, Box Elder and Havre, and also to parties residing along the line for operating pumps for irrigating purposes.

CUTBANK, MONT.—The proposition to grant an electric-light franchise to W. O. Scott and associates, of Coeur d'Alene, will be submitted to a vote on June 17. If the franchise is granted, a dam will be built across the Cutbank River.

HASTINGS, NEB.—The City Council has refused to grant the Hastings Ht. & Pwr. Co. a franchise to supply direct current and steam heat. As a substitute the Council has agreed to take up the question of the city furnishing electricity for manufacturing purposes and the erection of a substation in the business district to furnish direct-current service, using the exhaust steam for heating the business blocks. C. J. Miles is Mayor.

GARDNERVILLE, NEV.—Plans are being considered by F. W. Sarman, of the Douglas Flour Mill, for removing the flour mill from the Sarman ranch to Gardnerville. It is proposed to utilize the present water power on the Carson River to generate electricity, which will be transmitted to Gardnerville, a distance of 6 miles, to operate the mill, also for other industries and lighting the town.

FORT MOTT, N. J.—Bids will be received by the quartermaster, Fort Salem, N. J., until June 15 for furnishing and installing electric-light fixtures at this post.

OCEAN GROVE, N. J.—Plans are being prepared for the installation of a new lighting system on the boardwalk and on streets leading to the walk. It is proposed to use the inverted arc lamps mounted on ornamental iron posts.

PATERSON, N. J.—Plans are being considered for installing a new street-lighting system on Market Street. It is proposed to erect ornamental standards carrying five tungsten lamp clusters. The cost of the system is estimated at $18,000.

LAS CRUCES, N. M.—Plans are being considered for the installation of an electric power plant at the State Agricultural College for the purpose of supplying electricity to operate the irrigation pumps upon the farm of the institution.

BINGHAMTON, N. Y.—In a special message to the Council Mayor Irving recommended the extension of the boulevard lighting system in a modified form to other streets of the city.

BROOKLYN, N. Y.—An appropriation amounting to $13,500 has been made for additional street lighting in Brooklyn and Queens.

BROOKLYN, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, Department of Education, Park Avenue and Fifty-ninth Street, New York, until June 24, for installing electric ash hoists in Public School 64, Belmont and Atkins Avenues and Berriman Street, and Public School 75, Evergreen Avenue and Grove Street, borough of Brooklyn; also for installing electric freight elevator in the Manual Training High School, Seventh Avenue, between Fourth and Fifth Streets, borough of Brooklyn. Blank forms, plans and specifications may be obtained at the above office and also at the branch office, 131 Livingston Street, borough of Brooklyn.

CALDWELL, N. Y.—The Public Service Commission has granted Charles S. Wood permission to construct an electrical distributing system a distance of 4 miles along the lake road of Lake George in the town of Caldwell. Electricity for operating the system will be purchased from the Adirondack El. Pwr. Corpn. Caldwell has not a post office.

CORNING, N. Y.—The officials of the Corning & Painted Post St. Ry. Co. have agreed to extend their railway to the North Corning yards, provided a lease of Sebring Park can be secured for a term of years long enough to warrant building an amusement park. The railway company will erect a high-tension transmission line from Brown's Crossing to the western end of Market Street.

KENMORE, N. Y.—The Village Council has granted the Buffalo General El. Co. a franchise to supply electricity for lamps and motors here. Work will begin on the erection of the system as soon as the company secures authority from the Public Service Commission to make the extension.

NEW YORK, N. Y.—Bids will be received by Patrick A. Whitney, commissioner of correction, Department of Correction, 148 East Twentieth Street, New York, until June 18 for furnishing materials and installing engines, generators, switchboard, conduits, wiring, altering the present two-wire generators to three-wire, including all appliances, apparatus, instruments, etc. Blank forms and further information may be obtained and plans and drawings seen at the above office.

ROME, N. Y.—The Board of Public Works is considering the matter of installing an ornamental street-lighting system in the business district.

WATERTOWN, N. Y.—The Watertown Lt. & Pwr. Co. is planning to place its wires underground in the business portion of the city.

SHELBY, N. C.—Ladshaw & Ladshaw, engineers, Spartanburg, S. C., it is reported, are interested in a project to construct a hydroelectric power plant at Suttlemyre, near Shelby.

BUFFALO, N. D.—The installation of an electric-light plant in Buffalo is under consideration.

CARRINGTON, N. D.—The local telephone system will be entirely rebuilt this summer.

JAMESTOWN, N. D.—The contract for installing street-lighting system has been awarded to Crambs & Peet, Bismark, N. D., at $11,337.

ASHTABULA, OHIO.—Plans are being prepared by L. A. Amsden, city engineer, for extensions to the municipal electric-light plant. M. H. Turner is director of public service.

CINCINNATI, OHIO.—The Cincinnati & Suburban Bell. Tel. Co. has engaged Harry Hake, architect, to prepare plans for the erection of a new building, to be located at Fourth Avenue and Hammond Street. The Public Service Commission recently granted the company permission to issue $580,000 in capital stock for the purpose of erecting the building and installing a new switchboard.

CLEVELAND, OHIO.—Plans are being prepared by the Kinney & Levan Co., manufacturer of crockery, for the construction of a new building, 100 ft. x 460 ft. A power and heating plant and complete electric-lighting system will be installed. Walker & Weeks are engineers.

EAST LIVERPOOL, OHIO.—The Council has instructed the city solicitor to prepare a resolution authorizing a special election to vote on the proposition to establish a municipal electric-light plant.

FOSTORIA, OHIO.—The City Council has granted E. O. Cross, representative of the American Gas & El. Co., a 35-year lighting and power franchise. The company has an option on the plant of the Standard Lt. & Pwr. Co. and will take over the street-lighting contract and furnish the service at $60 per lamp per year, instead of $69.25, which the city is now paying.

SANDUSKY, OHIO.—At an election held May 31 the proposition to issue $160,000 in bonds for the installation of a municipal electric-light plant was defeated.

WELLSVILLE, OHIO.—A committee has been appointed to make investigation as to the cost of the installation of a municipal electric-light plant and the probable cost of operation per lamp as compared with the cost of the present service furnished by the Tri-State Ry. & Lt. Co., East Liverpool.

ASTORIA, ORE.—Surveys are now being made and work will soon begin on the construction of the proposed electric railway from Astoria to Seaside, a distance of about 20 miles. Mr. Robinson, Astoria, is interested in the project.

EUGENE, ORE.—Preparations are being made to install a series tungsten ornamental street-lighting system on the principal business streets in the city and in the city park property.

EUGENE, ORE.—Plans are being prepared by the Oregon Pwr. Co. for the construction of a hydroelectric power plant at Martin's Rapids, near here. The proposed plant will cost about $1,000,000 and will develop from 12,000 hp to 14,000 hp.

PORTLAND, ORE.—The Portland, Eugene & Eastern Ry. Co. will soon apply for a franchise to extend its Willamette Valley system into Portland.

PANAMA.—Sealed proposals will be received at the office of the general purchasing officer, Isthmian Canal Commission, Washington, D. C., until July 8, for auxiliary electrical equipment for the Gatun hydroelectric station, including switchboards, switching group, transformers, battery, air compressor and crane equipment. Blanks and general information relating to this circular (715) may be obtained from the above office or at the office of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Major F. C. Boggs is general purchasing officer.

HARRISBURG, PA.—Application will soon be made by David S. Wolf, Allen A. Beaver and Grant E. Alleman, all of Shoemakersville, for charters for the Shoemakersville El. Co., which proposes to supply electricity for lamps, heat and motors in Perry Township; the Windsor Castle El. Co., to supply a similar service in Windsor Township, and the Hamburg El. Co., to operate in Tilden Township and West Hamburg.

LANCASTER, PA.—The Christian Suburban El. Co. has given notice of an issue of $100,000 in bonds.

LOCK HAVEN, PA.—Steps have been taken toward the installation of an ornamental lighting system in the business district.

PITTSBURGH, PA.—The merger of 13 water-power companies to operate on the Clarion River has been approved by the State Water Supply Commission. The companies were consolidated under the name of the Clarion River Pwr. Co., capitalized at $65,000. The incorporators are: J. P. Fife, J. R. Paul and H. W. Douglas. The office of the company is located in Pittsburgh.

PITTSBURGH, PA.—Sealed proposals will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until June 24 for the installation, complete, of a new electric elevator plant in the United States court house and post office building, Pittsburgh, Pa., in accordance with drawings and specifications, copies of which may be obtained at the above office or at the office of the custodian. James Knox Taylor is supervising architect.

ST. CLAIR, PA.—Residents of St. Clair have applied to the Schuylkill County Court to grant an injunction to prevent improvements to the municipal electric plant. It is proposed to install new engines.

WASHINGTON, PA.—The Relief El. Lt., Ht. & Pwr. Co., of Washington, has applied for charters to operate in the borough of Washington, Chartiers Township, Cecil Township, borough of Houston, South Strabane Township, North Strabane Township, East Washington, Canton Township and the borough of Canonsburg. Charters for these nine different corporations acting under the same company have been applied for by J. M. Ralston, C. M. Brownlee and J. L. Cockins. As soon as charters are awarded work will be started on the construction of a large power plant in Washington to supply electricity for the places named.

PROVIDENCE, R. I.—The Narragansett El. Ltg. Co. has erected five-lamp clusters and two inverted arc lamps on ornamental standards in the rear of the Union Station for demonstration purposes.

ANDERSON, S. C.—The property of the Anderson Wtr., Lt. & Pwr. Co., including the water and light system in this city and the Postman Shoals power plant on the Geneva River, has been purchased by W. S. Lee, vice-president and general manager of the Southern Pwr. Co.; C. Elmer Smith, president of the S. Morgan Smith Co., of York, Pa., and Elliott G. Stevenson, of Detroit, Mich., and Toronto, Can. It is stated that negotiations are under way by the purchasers of the above property by which they will lease the plant of the Savannah River Pwr. Co., recently purchased by the Georgia Ry. & Pwr. Co., and that, in addition to operating the Gregg Shoals power plant on the Savannah River, Cherokee Shoals, 10 miles below Gregg Shoals, capable of developing 10,000 hp, will probably be developed at an early date.

ABERDEEN, S. D.—At an election held May 28 the citizens voted in favor of the amendment of the franchise of the Aberdeen Lt. & Pwr. Co. granting the company permission to raise its rates for electricity for lamps and motors. Under the terms of the amendment the company agrees to construct a new steam power plant, to cost $125,000, work on which will begin at once.

HIGHMORE, S. D.—Plans are being considered for the installation of an electric-light plant in Highmore.

VALLEY SPRINGS, S. D.—The City Council is making investigations with a view of establishing a municipal electric-light plant here.

MOUNTAIN CITY, TENN.—W. W. Worley, Vaughtsville, is contemplating installing an electric-light plant n Mountain City this summer.

NASHVILLE, TENN.—The city has agreed to furnish electricity for lighting the State Capitol free of charge, provided the Capitol Commission will renew the insulation and install weatherproof conduits.

BRYAN, TEX.—The capital stock of the Bryan Tel. Co. has been increased from $14,000 to $28,000.

COLEMAN, TEX.—Steps have been taken by the City Council toward the installation of an electric light and power plant.

DALLAS, TEX.—Plans are being considered by the Texas El. Co. for the construction of a large electric generating station to supply electricity for the interurban railways of the Trinity Valley Traction Co.

FORT WORTH, TEX.—The Baptist Seminary St. Ry. Co., recently organized with a capital stock of $26,000, is planning to construct an interurban electric railway from Fort Worth to suburban points. L. R. Scarbrough, J. K. Winston and H. C. McCart are incorporators.

POST, TEX.—The Post Pwr. Co., recently incorporated, has awarded all contracts for its proposed power plant. The power station will be 86 ft. x 96 ft., of reinforced-concrete construction. The plant will have an output of 1000 hp. H. W. Fairbanks is general manager.

SAN ANTONIO, TEX.—Dr. F. S. Pearson, of New York, and associates, who are interested in the Medina Valley Irrigation Co., which is constructing dams across the Medina River and building an irrigation system to cost about $8,000,000, have under consideration the proposition of constructing an interurban railway between San Antonio and the site of the main dam through the 60,000-acre tract that is to be irrigated and upon which four new towns are being established.

MOUNT PLEASANT, UTAH.—The city administration is considering the question of taking over the local electric plant, owned by the Mount Pleasant Mill & Pwr. Co., and making improvements to same. The company has offered to enlarge the plant provided the city will not grant franchises to competitors. It is estimated that it will cost from $35,000 to $40,000 to purchase the plant and equip it to meet present demands.

EAST CLARENDON, VT.—The Rutland Ry., Lt. & Pwr. Co. is planning to build a large dam and power plant at Clarendon Gorge on Mill River, at East Clarendon, work on which will begin at once.

EPHRATA, WASH.—The City Council has granted Martin Kramer and T. G. Anderson, Seattle, Wash., a franchise to install an electric-light plant. It is proposed to install a 500-hp plant and supply electricity for lamps and motors in the Ephrata Valley.

SEATTLE, WASH.—The city of Seattle is contemplating the construction of a dam on Cedar River, at a cost of about $1,100,000. A. H. Dimmock is city engineer.

BLACKSVILLE, W. VA.—The Monongalia County Court has authorized the citizens of Clay District to vote on a bond issue of $200,000 to insure the immediate extension of the Morgantown & Dunkard Valley street railway from its present terminus to Blacksville, where it will connect with the Waynesburg-Blacksville line, now in process of construction, and will eventually form part of the electric railway system from Grafton, W. Va., to Pittsburgh, Pa. J. A. Martin, Morgantown, is general manager.

WHEELING, W. VA.—Steps have been taken by the Board of Trade to change the entire street-lighting system in the business district, substituting arc lamps for tungsten lamps mounted on ornamental standards.

CHETEK, WIS.—The Chetek Tel. Co. is extending its system into Rusk County.

HALIFAX, N. S., CAN.—The city plans to acquire the electric lamp-posts of the Halifax El. Tramway Co. It is proposed to offer the company $10,500 for the 1350 lamp-posts to be taken over by the city. In case the company refuses this offer expropriation proceedings will follow.

BARRIE, ONT., CAN.—The ratepayers have voted in favor of the by-law to secure electricity from the Hydro-Electric Commission; also for an appropriation of $7,000 for changes to the municipal electric-light plant for the distribution of hydroelectric power. Work will begin immediately on the erection of a transmission line from Waubaushene to Barrie. The town has contracted for 700 hp.

COLLINGWOOD, ONT., CAN.—The by-law authorizing an appropriation of $30,000 for the purpose of equipping the municipal electric plant to utilize hydroelectric power and to equip the pumping station of the water-works system for electrical operation will be submitted to a vote on July 3. The agreement with the Hydro-Electric Commission calls for 700 hp, at $34 per hp, to be transmitted from the Big Chute on the Severn River.

GALT, ONT., CAN.—A by-law to appropriate $45,000 to complete the hydroelectric system will soon be submitted to tne ratepayers. The money is required to complete the street-lighting system and to make further extensions and purchase new equipment.

TORONTO, ONT., CAN.—Sections of York Township, including Woodbine Heights and Fodmorden districts, may be lighted by current supplied by the Toronto Hydro-Electric system in the near future. The city is contemplating entering into competition with the Toronto El. Lt. Co. for the franchise in York Township.

TORONTO, ONT., CAN.—Arrangements are being made by the Ontario provincial government to utilize Niagara power in the Parliament Buildings after the contract with the Toronto El. Lt. Co. expires. Preparations are now being made by the Public Works Department to install equipment to convert the Niagara power from direct to alternating current. The contract with the Toronto company expires in August.

WELLAND, ONT., CAN.—The Town Council is considering the question of establishing a municipal electric plant. It is proposed to secure electricity from the Hydro-Electric Commission and plans are being prepared.

QUEBEC, QUE., CAN.—The Stadacona Hydraulic Co., which owns the seven falls of St. Ferreol, with a total head of 400 ft., on Ste. Anne River, capable of developing 10,000 electric hp, is planning to install

a hydroelectric power plant. The initial installation provides for 1000 hp. The total output of the plant has been sold for a long period of years to the Quebec Ry., Lt., Ht. & Pwr. Co. and the Bayless Pulp & Paper Co., of Pennsylvania. The last-named company is planning to erect a paper mill at Beaupré, 5 miles from the proposed power plant.

SCOTSTOWN, QUE., CAN.—The municipal power plant was carried away when the dam belonging to the Emberton Lumber Co. gave way.

OUTLOOK, SASK., CAN.—The by-law appropriating $15,000 for the installation of an electric-light system was carried.

REGINA, SASK., CAN.—It is reported that the government of Saskatchewan has entered into a contract by which the Canadian Pacific, Canadian Northern and Grand Trunk Pacific railway companies will expend $20,000,000 diverting the South Saskatchewan River to supply water to Regina, Moose Jaw, Weyburn and other cities. The project also includes a hydroelectric power development of 30,000 hp. A commission has been appointed to prepare plans.

MEXICO CITY, MEX.—Application has been made to the federal government by Mrs. Elena Davalos for a concession to construct a cable road railroad from Villa de Guadalupe to the top of Tepeyac Hill.

SAN LUIS POTOSI, MEX.—Preliminary arrangements have been completed by the Mexico Hydro El. Co. for the installation of a hydroelectric plant on the Naranjo River. The proposed plant will develop 75,000 hp. The company proposes to erect transmission lines to all of the principal cities and industrial centers in the states of San Luis Potosi, Tamaulipas, Nuevo Leon and Vera Cruz.

New Industrial Companies

THE ATHENS ELECTRO-CHEMICAL COMPANY, of Athens, N. Y., has been chartered with a capital stock of $10,000. The directors are: William T. Hoofnagle, Fritz Lowenstein and Malcolm W. Clephane, of New York, N. Y.

THE CRYSTALITE LAMP COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $10,000 to manufacture and sell glass lamp reflectors and specialties. The incorporators are: Frank H. Harlowk, Julius H. Gewke and William J. Moore.

THE ELECTRIC COMPANY OF CANADA, of Toronto, Ont., Can., has been incorporated with a capital stock of $1,000,000 to do a general manufacturing and contracting business. The directors are: G. H. Sedgewick, A. G. Ross and A. E. Langman, all of Toronto.

THE KEENE-JUDD COMPANY, of Chicago, Ill., has been granted a charter with a capital stock of $2,500 to manufacture and deal in electrical machinery and to do general contracting work. The incorporators are: Charles G. Hendricks, Carl O. Beroth and A. W. Westergroom.

THE SEELEY ELECTRICAL LABORATORY, of Los Angeles, Cal., has been incorporated with a capital stock of $300,000 by W. A. Sweeney, J. E. Seeley, O. E. Campbell, W. D. Nickum, M. T. Terry, C. H. Bradley and J. P. Stocksdale.

THE UNION ELECTRIC CAR COMPANY, of Rochester, N. Y., has filed articles of incorporation with a capital stock of $5,000 for the purpose of doing a general business in motor vehicles. The directors are: Arthur McNall, Henry J. Schneider and Harry E. Pramer, all of Rochester, N. Y.

THE UNITED ELECTRIC SUPPLY COMPANY, of New York, N. Y., has been incorporated with a capital stock of $100,000 to manufacture mechanical and electrical appliances, etc. The incorporators are Anselm P. Anderson, 32 Liberty Street; Oscar B. Frazer, 34 Nassau Street, and John G. Clark, 32 Nassau Street, all of New York, N. Y.

New Incorporations

ST. LOUIS, MO.—The St. Louis County El. Lt. & Pwr. Co. has been organized by David P. Leahy, Philip A. Smith, Richard J. Baldwin and Stephen J. Leahy. The company is capitalized at $15,000 and proposes to supply electricity in Jennings, West Walnut Manor and other county towns. The power plant, which is nearly completed, is located in West Walnut Manor and will be operated in connection with the Jennings Heights street-car line. The company has a franchise to supply electricity in Central and St. Ferdinand Townships and a contract for lighting the streets of Jennings.

BORDENTOWN, N. J.—The Bordentown El. Co. has been incorporated with a capital stock of $50,000 for the purpose of distributing electricity. The directors are: H. H. Aikens, of Philadelphia, Pa., president; H. C. Thompson, Jr., Philadelphia, Pa., and J. D. McMullin, Moorestown.

PATERSON, N. J.—The Ransom Wave Motor Co. has been incorporated with a capital stock of $60,000 for the purpose of operating power plants generating electricity from ocean waves. The incorporators are: A. T. Ransom, J. Hunt and A. Droll, of Brooklyn, N. Y.

LORDSBURG, N. M.—The Lordsburg Wtr., Ice & El. Co. has been incorporated with a capital stock of $50,000 by R. E. Cameron, M. Crocker, Frank R. Coon, J. R. Ownby and D. H. Kedzie. The company proposes to conduct a water supply, ice, cold storage, gas and electric transmission business.

ADAMS, N. Y.—The Adams El. Lt. Co. has been incorporated by Mark B. Steele, Jennie F. Steele and A. P. Steele. The company is capitalized at $20,000 and proposes to supply electricity for lamps, heating and motors in the towns of Watertown, Henderson, Ellisburg, Lorraine, Rodman and Adams.

Trade Publications

LAMPS FOR ELECTRIC RAILWAY SERVICE.—Bulletin 4947 of the General Electric Company contains illustrations and descriptions of graphitized and tungsten lamps especially adapted for street railway car illumination, showing them in comparison with results from the use of the oil carbon-filament lamp.

CUT-OUT HANGERS.—Thompson safety cut-out hangers are exploited in an eight-page catalog issued by the Thompson Electric Company, Cleveland, Ohio. Illustrations of and information with respect to the operation of the hangers, the proper care of mill clusters and tungstens, how the ropes are rigged and dimensions, prices and discounts are given.

STORAGE BATTERIES.—The Electric Storage Battery Company, Philadelphia, has issued in blueprint form a map of the United States showing the location of its sales offices at Philadelphia, New York, Boston, Chicago, St. Louis, Cleveland, Atlanta, Denver, Detroit, San Francisco, Portland, Seattle, Los Angeles, and one in Canada at Toronto.

ELECTRIC VEHICLES.—"The Electric Truck as an Investment" is the subject of a sixteen-page brochure issued by the General Vehicle Company of Long Island City, N. Y., as publication No. 520. It contains a good deal of the "human interest" element, giving, as it does, the practical experience of some of the largest users of electric motor trucks and telling in a convincing way of actual results obtained and the economies effected. Actual figures are given of costs of operation and repairs, in one case extending over a period of five and one-half years and in another over a period of four years.

Business Notes

THE D. VAN NOSTRAND COMPANY has moved its New York office from 23 Murray Street to 25 Park Place.

THE ELUX MINIATURE LAMP WORKS OF THE GENERAL ELECTRIC COMPANY have moved their office from the Bible House to 324 Lafayette Street, New York, N. Y.

THE DEAN-LIBBY-BRACKETT ENGINEERING COMPANY has been dissolved. The assets have been taken over by Mr. William W. Dean, who will continue the business under his name.

THE DEARBORN DRUG & CHEMICAL WORKS have removed their Indianapolis office to 19 Hume Mansur Building. Mr. J. F. McDonnell has been appointed manager of the office.

MILLER & PARDEE.—Lindsay H. Miller and Harvey S. Pardee have opened an office at 133 West Washington Street, Chicago, Ill., for the practice of illuminating and electrical engineering.

THE SUBURBAN EQUIPMENT COMPANY, which has taken over the business of Otis Wells & Company, has opened offices at 39 Cortlandt Street, New York. The president of the company is Mr. Charles A. Barker and the treasurer Mr. Harry G. Otis.

ALBERGER PUMP & CONDENSER COMPANY.—Work now being executed at the shops of the Alberger Pump & Condenser Company includes orders from the Isthmian Canal Commission, the United States Navy Department, the American Gas & Electric Company, the Public Service Corporation of New Jersey, the Cleveland Electric Illuminating Company and the Robins Dry Dock & Repair Company.

ASHLEY & KAUFMAN, of New York City, have established a Chicago office at 14 International Amphitheatre, Union Stockyards. This office will be in charge of Mr. John Fallon, formerly with the Tennessee Copper Company. Messrs. Ashley & Kaufman have recently been retained as consulting engineers on the light, heat and sanitary engineering for the Union Stock Yards and the new Central Manufacturing District of Chicago.

THE H. M. HIRSCHBERG COMPANY.—The H. M. Hirschberg Company, 30 East Twentieth Street, New York, which was recently incorporated to manufacture and deal in lighting equipment, will carry on the representation of the Siemens-Schuckertwerke arc lamps in this country and also the Plania arc-lamp electrode business heretofore conducted personally by Mr. H. M. Hirschberg. Reference to these agencies was made in the *Electrical World* for May 18, 1912, page 1086.

COVINGTON MACHINE COMPANY.—Recent installations of Covington oil engines, which are built by the Covington (Va.) Machine Company, include generating sets for the Hotel Navarre and the Hotel Broad, Newark, N. J. Each of these sets has a rated output of 35 kw. In addition to the lighting and elevator load, the set in the Hotel Broad also furnishes energy for a refrigerating machine. Another recent installation of the same size set was made in the factory of the H. Krautz Manufacturing Company, Brooklyn, N. Y.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JUNE 4, 1912.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York.]

1,028,104. STRAIN INSULATOR; O. L. Fletcher, Peru, Ind. App. filed Aug. 16, 1911. A grooved block for guy wires, etc.

1,028,107. ELECTRICALLY HEATED CULINARY APPARATUS; W. S. Hadaway, Jr., and E. E. Rose, East Orange, N. J., and Pittsburgh, Pa. App. filed Oct. 8, 1910. Double-walled receptacle with intermediate heating element.

1,028,112. MEANS FOR COUNTERACTING ARCS; R. E. Hellmund, Great Barrington, Mass. App. filed Feb. 3, 1905. Hand-operated oil-brake switch.

1,028,118. TUBULAR INCANDESCENT LAMP; E. R. Knowles, New York, N. Y. App. filed Jan. 12, 1910. Filament anchor.

1,028,150. ELECTRODE COLLAR FOR ELECTRIC FURNACES; E. R. Taylor, Penn Yan, N. Y. App. filed Jan. 17, 1911. Gas seal for endwise movable stemless electrodes.

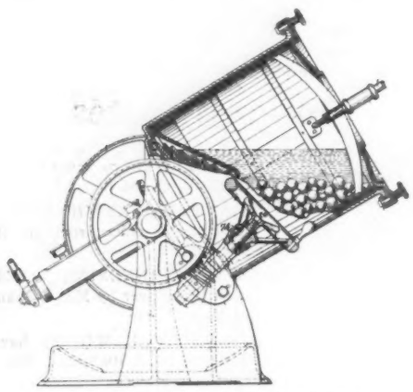
1,028,151. REDUCTION OF REFRACTORY ORES; F. J. Tone, Niagara Falls, N. Y. App. filed April 8, 1907. The reduction chamber is kept closed so that the volatilization increases the pressure and promotes condensation.

1,028,173. SAFETY FUSE; H. A. Yates, New York, N. Y. App. filed July 11, 1911. Cartridge type with fusible spider.

1,028,189. SPRING JOINT FOR TROLLEY POLES; R. F. Coleman, Philadelphia, Pa. App. filed June 10, 1911. Hinge and spring joint.

1,028,202. ELECTRIC MAGNETO MACHINE; G. W. Foye, Fredericksburg, Va. App. filed Sept. 10, 1909. Dental motor.

1,028,204. METHODS OF AND APPARATUS FOR PRODUCING ELECTRIC OSCILLATIONS; R. C. Galletti, Rome, Italy. App. filed Jan. 27, 1908. Impedance devices between a direct-current source and auxiliary oscillatory circuits.



1,028,786—Electroplating Apparatus.

1,028,254. METER-TESTING CUT-OUT; T. E. Murray, New York, N. Y. App. filed June 29, 1911. An auxiliary load and an auxiliary fuse are simultaneously connected to the service leads.

1,028,255. FUSE CASE; T. E. Murray, New York, N. Y. App. filed Sept. 11, 1911. A cartridge-type fuse has laterally projecting plug terminals.

1,028,256. ELECTRIC CUT-OUT; T. E. Murray, New York, N. Y. App. filed Oct. 4, 1911. Branch circuits are taken directly from the main circuit conductors with a removable fuse in each lead.

1,028,257. JOINT FOR SHEATHED CONDUCTORS; T. E. Murray, New York, N. Y. App. filed June 29, 1911. Uses lead and lead floss.

1,028,258. ELECTRIC CUT-OUT; T. E. Murray, New York, N. Y. App. filed Dec. 9, 1911. Two-compartment plug switch.

1,028,259. CONNECTION DEVICE FOR CIRCUIT CONDUCTORS; T. E. Murray, New York, N. Y. App. filed Feb. 9, 1912. Interchangeable insulating block units with plug switches.

1,028,260. JUNCTION BOX FOR CIRCUIT CONDUCTORS; T. E. Murray, New York, N. Y. App. filed Sept. 11, 1911. Porcelain casing with metal sheath.

1,028,268. CASE FOR METER CONNECTION BLOCKS; G. E. Palmer, Hartford, Conn. App. filed Oct. 11, 1911. Adaptable to meters of different types.

1,028,303. SILICON PRODUCTS; F. J. Tone, Niagara Falls, N. Y. App. filed March 4, 1912. A refractory condensation product of silicon, oxygen and carbon of felt-like, pliant structure of high thermal resistivity.

1,028,326. COLLAPSIBLE CABINET; F. F. Burdick, River Forest, Ill. App. filed March 11, 1912. For electric-light "baths."

1,028,328. ELECTRIC FUSE; G. W. Christians, New York, N. Y. App. filed Dec. 27, 1911. Looped continuous fuse wire supported on an insulating rod.

1,028,332. AUTOMATIC MOTOR CONTROL; M. W. Day, Schenectady, N. Y. App. filed July 15, 1909. For elevators, hoists, etc., to regulate retardation.

1,028,350. ELECTRIC SWITCH; M. Guett, Hartford, Conn. App. filed Sept. 20, 1910. Push-button type with straight-line movement.

1,028,354. GALVANIC BATTERY; A. Heil, Frankfort-on-the-Main, Germany. App. filed Jan. 14, 1911. Gradual amalgamation of the zinc elements in dry cells.

1,028,360. CIRCUIT-CONTROLLING DEVICE; F. Kästner, Berlin, Germany. App. filed Feb. 17, 1908. Stage dimmer.

1,028,364. SELF-STARTING DIRECT-CONNECTED GENERATOR; C. D. Knight and W. O. Lum, Schenectady, N. Y. App. filed Oct. 14, 1910. The generator is driven by an internal-combustion engine.

1,028,370. TELEPHONE ATTACHMENT; T. L. Ludwig, Sandusky, Ohio. App. filed April 26, 1911. For supporting the receiver near the ear.

1,028,383. ELECTRIC HEATER; L. F. Parkhurst, Pittsfield, Mass. App. filed April 26, 1909. A fluid receptacle is resiliently clamped to the heating unit.

1,028,385. ELECTROMAGNET; E. Price, Schenectady, N. Y. App. filed Dec. 26, 1911. For releasing or applying brakes.

1,028,394. APPARATUS FOR ACTUATING THE CONDUIT COVERS OF ELECTRIC RAILWAYS; D. D. Samaia, Vincenza, Italy. App. filed April 28, 1910. Arms adapted to enter the trolley slot and spread the cover sections.

1,028,405. SELECTIVE ALTERNATING-DIRECT-CURRENT SYSTEM; J. F. Tritle, Schenectady, N. Y. App. filed July 27, 1908. For cars intended for operation on alternating-current or direct-current circuits.

1,028,414. POWER GENERATOR; V. C. de Ybarrondo, Los Angeles, Cal. App. filed Oct. 20, 1909. Electrically heated steam boilers.

1,028,429. SWIVEL-PLUG ATTACHMENT; A. W. Buell, St. Paul, Minn. App. filed Sept. 5, 1911. For electric-lamp sockets.

1,028,444. PROTECTIVE COVERING FOR RESISTANCE CONDUCTORS; J. T. H. Dempster, Schenectady, N. Y. App. filed March 20, 1909. Aluminum oxide and an aluminate between the conductor and the mica insulation.

1,028,483. RAIL JOINT; W. Nalepka, South Omaha, Neb. App. filed Sept. 1, 1911. A spring connector.

1,028,495. ELECTRIC SELF-PLAYING VIOLIN; H. K. Sandell, Chicago, Ill. App. filed Jan. 3, 1911. Expression control. (Improvement on Patent No. 807,871.)

1,028,516. PRODUCTION OF CONTINUOUS ELECTRIC ARCS AND APPARATUS THEREFOR; F. H. A. Wielgolaski and O. Schönher, Christiania, Norway. App. filed March 12, 1910. Furnace with circular peripheral electrode. (See Patent No. 930,238.)

1,028,534. INSULATOR; C. C. Brady, Ezra, Ky. App. filed Sept. 28, 1911. Porcelain block for telephone wire with drainage channel.

1,028,568. ELECTRIC LOCK; W. S. Henry, Rochester, N. Y. App. filed May 8, 1911. Remote control with signal device.

1,028,579. CONNECTOR FOR CONDUITS AND PIPES; G. A. Lutz, Plainfield, N. J. App. filed Sept. 23, 1909. Angle joint for connecting iron conduit with metal molding.

1,028,580. ELECTRIC SADIRON; E. H. Lux, Logansport, Ind. App. filed July 17, 1911. A casing with a removable heating unit.

1,028,613. BATTERY-ELEMENT SUPPORT; C. B. Schoenmehl, Waterbury, Conn. App. filed Aug. 19, 1910. Primary battery with copper oxide depolarizer and a zinc plate.

1,028,614. PRIMARY BATTERY; C. B. Schoenmehl, Waterbury, Conn. App. filed Oct. 15, 1910. A single support for the two electrodes.

1,028,629. TROLLEY; S. De C. Stone, Somerville, Mass. App. filed July 10, 1910. Replacing guards.

1,028,635. TELEPHONE SYSTEM; D. L. Temple, Lewistown, Pa. App. filed July 18, 1903. Metallic-circuit, central-energy testing and signaling circuits.

1,028,636. METHOD OF EXHAUSTING VESSELS; C. J. Thatcher, Upper Nyack, N. Y. App. filed March 30, 1910. Preliminary mechanical exhaustion of a lamp bulb and then passing a current through the filament to precipitate the residual gases.

1,028,639. INSULATED SWITCH COVER; A. A. Tirrill, Schenectady, N. Y. App. filed April 14, 1910. A lug for holding a fiber lining in place.

1,028,647. FUSE; G. R. Willett, Pittsburgh, Pa. App. filed Oct. 27, 1911. Cartridge type with detachable caps.

1,028,668. SUPPORT FOR THIRD RAILS; E. J. Blair, Chicago, Ill. App. filed Sept. 2, 1911. Insulating standard with a clamping top.

1,028,712. LID FOR COOKING UTENSILS; A. Gregory, Durango, Mexico. App. filed Oct. 21, 1911. A heating element is secured in the cover for browning or crusting, etc.

1,028,715. MAXIMUM-INDICATING AND WATT-HOUR METER; C. I. Hall, Chicago, Ill. App. filed Aug. 14, 1911. The indicating mechanism is driven by a spring and the integrating wattmeter acts as an escapement.

1,028,719. ELECTRIC-LAMP SOCKET; H. T. Hartwig, Hartford, Conn. App. filed Dec. 14, 1910. A corrugated fiber lining for spacing the switch block or lamp base from the shell.

1,028,731. CONTROLLING APPARATUS FOR ELECTRIC MOTORS; J. D. Ihlder, New York, N. Y. App. filed Dec. 6, 1907. Improvement on Patent No. 851,239 for elevators, etc.

1,028,785. TROLLEY ADJUSTER; W. J. Reeder, Louisville, Ky. App. filed July 22, 1911. To prevent the trolley pole from jumping.

1,028,786. ELECTROPLATING APPARATUS; M. Reid, Cleveland, Ohio. App. filed Dec. 10, 1908. Tilting and rotatable tumbling barrel.

1,028,790. SIGNALING SYSTEM; H. O. Rugh, Sandwich, Ill. App. filed Sept. 1, 1910. Circuit-controlling call box for selective signaling.

1,028,832. FURNACE FOR SINTERING METALLIC FILAMENTS FOR ELECTRIC INCANDESCENT LAMPS; C. Trenzen and E. Haagan, Cologne-Braunsfeld and Hanau, Germany. App. filed Jan. 21, 1911. The filaments are treated in a tube of iridium.